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Feeding Pigs on Forage

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FEEDING PIGS ON FORAGE

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VALUE OF FORAGE FOR PIGS

FEED SAVED BY PASTURE

One of the first questions to consider with reference to forage crops for pigs is whether it is really worth-while to provide pasture for them. Table 1 summarizes 13 experiments in which pigs on Dwarf Essex rape or red clover pasture were compared with similar pigs having no forage. Rations of yellow corn and tankage were fed.

TABLE 1.—Comparison of Feeding Pigs in Dry Lot and on Forage

	Dry lot	Red clover or rape pasture
Acres of forage	0	5.25
Number of trials	13	13
Number of pigs at beginning	73	98
Number of pigs at close	64	97
Initial weight per pig, lb.	54.3	51.4
Final weight per pig, lb.	191.6	191.1
Average daily gain, lb.	**1.09**	**1.32**
Days required to gain 150 lb.	138	114
Daily feed per pig, lb.:		
Corn	4.09	4.47
Tankage	0.38	0.32
Salt	0.005	0.01
Total	4.47	4.80
Daily feed per 100 lb. live weight, lb.	3.64	3.96
Feed per 100 lb. gain, lb.:		
Corn	374.17	338.37
Tankage	34.53	24.64
Salt	0.47	0.45
Total	**409.17**	**363.46**
Cost of feed per 100 lb. gain	$ 5.03	$ 4.40
Cost of feed and pasture per 100 lb. gain	.....	$ 4.93
Gain in live weight per acre of forage, lb.	.....	2583
Saving in cost of concentrates per acre of forage	.....	$ 16.27
Finishing date, from June 15	Oct. 31	Oct. 7
Selling price of hogs per 100 lb.	$ 7.39	$ 8.03*
Difference per acre due to higher selling price	.....	$ 16.53
Value of forage per acre	.....	**$ 32.80**

*Average price of hogs at Chicago for the 41st week of the year during the period 1904-1933, with the 5 years 1916-1920, inclusive, omitted. During the same period the average price was 8 per cent lower for the 45th than for the 41st week.

Ear corn 56¢ and shelled corn 59.5¢ a bu.; tankage $2.25, salt 75¢, and grinding corn 10¢ a 100 lb.; rape pasture $13.48 and clover $14 an acre. Two acres of clover and 3.25 acres of rape were utilized.

The pigs on pasture gained almost a quarter of a pound more daily a head and were ready for market 24 days earlier than those having no forage. The green feed not only stimulated the appetite and caused the pigs to consume a larger amount of other feed but also enabled them to produce more gain in live weight per pound of grain or concentrates consumed. When only this saving in feed per unit of gain was considered, at the prices used, it gave the pasture a value of $16.27 an acre.

EFFECT OF FORAGE ON RATE OF GROWTH AND SELLING PRICE

Since increasing receipts in the fall of the year ordinarily cause the price of hogs to decline as the season advances, early-marketed hogs usually bring a higher price than those marketed later. The average starting date of the 13 comparisons was June 23. The pigs on pasture were ready for market by October 14, or the forty-first week of the year, and those without pasture by November 10, or the forty-fifth week of the year. The average price of hogs at Chicago for the 25-year period from 1904 to 1933, with the five abnormal price years from 1916 to 1920, inclusive, omitted, was 8 per cent lower during the forty-fifth week than during the forty-first week. The probable difference in selling price due to the slower gains commonly made by pigs in dry lot should not be overlooked in a consideration of the value of forage for pigs. Based on the experiments reported and the prices used, this amounted to a difference in returns of $16.53 for each acre of forage.

INFLUENCE OF PASTURE ON THE HEALTH OF THE ANIMAL

Pasture has the further advantage of aiding in keeping the pigs in a healthy, vigorous condition. It not only supplies nutrients which may be lacking in the concentrate portion of the ration, thus tending to keep the animal healthier and more resistant to disease, but it also provides an environment under which conditions of sanitation are more easily maintained so that the chances of infection are greatly reduced. Of the pigs in the pasture groups in the experiments reported, 99 per cent of those placed on feed completed the experiments. Twelve per cent of those in the lots or groups having no green feed were removed from the lots during the course of the experiments because of unthriftiness or other causes.

Various methods of improving upon a corn and tankage ration for pigs in dry lot have been worked out; hence, under the most favorable conditions, it is possible to grow and fatten pigs successfully without pasture. It is much more difficult to grow them successfully without pasture, however, than with it. The benefit from pasture is greater for suckling and weanling pigs than for fattening shotes. Perhaps in the future and possibly under exceptional conditions at present, a breeding herd could be maintained and the pigs grown and fattened without being on pasture at any period of their lives. The average producer of hogs, however, would only be inviting failure to attempt such a procedure under the conditions and with the systems of feeding which now commonly prevail.

FACTORS AFFECTING THE VALUE OF A FORAGE CROP

A suitable forage crop for growing and fattening pigs is relatively high in protein and ash, contains a minimum of woody or fibrous material, is palatable, and is succulent in character. Its ease and cheapness of seeding, its ability to withstand trampling and grazing, its capacity to produce new growth and remain green (even during the hot dry weather of late summer), either its permanence or its fitness in a desirable rotation, and its adaptability to local soil and climatic conditions are all factors which influence the worth of a forage crop.

COMPOSITION OF FORAGE CROPS AS INFLUENCED BY DIFFERENT FACTORS

STAGE OF DEVELOPMENT

The data presented in Table 2 were gathered from different sources as indicated and show the composition of the dry matter of various forage crops, as well as that of some of the crops at different stages of development. As plants mature, they decrease in ash and protein and become more woody or fibrous in character.

TABLE 2.—Composition of Forage Crops at Different Stages of Development

	Source of data	Time of harvesting	Height when harvested	Moisture in original sample	Composition on a moisture-free basis				
					Ash	Crude protein (N x 6.25)	Carbohydrates		Fat (ether extract)
							Fiber	N-free extract	
			In.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Alfalfa	Hunt, O. A. E. S.	May 31			7.50	21.81	27.37	40.96	2.36
Alfalfa	Hunt, O. A. E. S.	June 10			6.61	18.86	34.72	37.61	2.20
Alfalfa	Hunt, O. A. E. S.	June 21			5.90	16.80	37.47	38.24	1.60
Red clover	Hunt, O. A. E. S.	June 10			6.68	16.90	25.13	47.86	3.43
Red clover	Hunt, O. A. E. S.	June 21			5.36	13.18	30.87	48.45	2.14
Sweet clover, 1st year	Ohio Bull. 405.				9.70	21.23	22.00	43.98	3.09
Sweet clover, 2nd year	Ohio Bull. 405.				9.05	13.49	39.83	35.20	2.43
Wheat	Ky. Bull. 175.		5	75.8	12.40	27.02	16.12	41.61	2.85
Wheat	Ky. Bull. 175.		24	78.2	8.04	10.62	27.39	50.96	2.99
Rye	Ky. Bull. 175.		5	81.9	11.99	35.91	11.00	36.13	4.97
Rye	Ky. Bull. 175.		27	82.8	9.26	15.83	24.45	46.68	3.78
Timothy	Mo. Res. Bull. 20	Mar. 16		72.3	7.44	12.59	22.48	55.34	2.15
Timothy	Mo. Res. Bull. 20	May 23	12	74.2	8.41	10.18	26.31	50.49	4.61
Timothy	Mo. Res. Bull. 20	June 6		65.5	6.10	5.90	33.74	51.89	2.38
Bluegrass	Hunt, O. A. E. S.	May 10	9	79.7	8.42	26.49	22.91	39.76	2.42
Bluegrass	Hunt, O. A. E. S.	June 9	15	78.0	7.85	16.83	23.21	48.43	3.68
Alsike	Feeds & Feeding			75.7	9.88	16.87	26.75	44.03	2.47
Red clover	Ky. Bull. 175.		11	81.2	10.72	22.99	14.08	49.07	3.14
Canada field peas	Feeds & Feeding			83.4	9.64	21.69	24.11	41.56	3.01
Soybeans	Ohio Bull. 242.		10	72.3	8.01	17.53	29.15	44.19	1.12
Dwarf Essex rape	Ohio Bull. 242.		10	87.8	12.42	20.48	18.26	49.95	1.89
Sudan grass	Feeds & Feeding			77.5	7.11	8.00	33.33	48.45	3.11
Spring-seeded winter wheat	Hunt, O. A. E. S.	July 3		79.3	11.01	26.28	18.61	38.76	5.34
Rye	Hunt, O. A. E. S.	May 18	12	83.5	9.75	24.51	19.64	42.06	4.04

In the 21-day period from May 31 to June 21 there was a 5 per cent decrease in the protein content and a 10 per cent increase in the fiber content of the dry matter of growing alfalfa.

The protein in the dry matter of red clover decreased 3.7 per cent and the fiber increased 5.7 per cent in the 11-day period from June 10 to June 21. Willard found from 3 years' work (1930-1932) that the protein in samples of clover hay taken at weekly intervals dropped at each interval from 19.8 per cent in that cut on May 19 to 10.8 per cent in that cut on July 11.

The 3-year (1930-1932) average protein content of samples of alsike hay cut at 7-day intervals likewise dropped from 20 per cent in the sample taken May 19 to 12.2 per cent in that taken June 30.

Two samples of hay of the first year's growth of sweet clover taken in July averaged 17.4 per cent of protein. Samples taken during seven different periods of 13 to 21 days each from August 1 to November 25, inclusive, showed average protein contents of 20.8, 18.7, 19.5, 18.4, 18.4, 16.4, and 15.6 per cent, respectively. Hay samples of the second year's growth taken during six periods of 9 to 16 days each from May 10 to July 17, inclusive, contained 21.0, 18.7, 16.9, 14.5, 13.9, and 11.9 per cent of protein, respectively.

During the early stages of their development, such crops as bluegrass, rye, wheat, and oats are high in protein and compare favorably in this respect with the leguminous crops, such as alfalfa, red clover, sweet clover, alsike, soybeans, and field peas. As they mature, they lose their nitrogenous character and no longer show a high nutritive value.

In an investigation carried on by McClure[1] at Columbus, three series of plots of Kentucky bluegrass were cut at different frequencies, or 12, 8, and 2 times during the season. One set of each series was fertilized with 25 pounds of nitrogen to the acre on March 26 and again on June 19. A second set was fertilized with 50 pounds of nitrogen to the acre on each of these dates. On April 5 the plots to be cut 12 and those to be cut 8 times contained averages of 23.3 and 23.0 per cent of protein, respectively. Clippings of the first series were made April 19 and 26. On May 8, when the first series was clipped for the fourth time and the second series for the second time, the dry matter of the grass from the two, as named, contained averages of 19.7 and 16.1 per cent of protein.

Both the first and second series were clipped on May 29 and June 18. The third series was clipped for the first time on June 18. The dry matter of the grass from the first, second, and third series then averaged 18.6, 17.5, and 9.0 per cent of protein, respectively.

The dry matter of the grass taken from the first and second series of plots on July 2, or shortly after applications of nitrogen at the high and low levels were made, contained averages of 23.1 and 22.7 per cent of protein, respectively. The first series of plots was clipped on July 15, 23, and 31, but the second series was not clipped again until the latter date. At that time the protein content of the dry matter from the two series averaged 20.7 and 16.5 per cent, respectively. The first and second series were clipped on August 29, and the last clipping was made on October 19. The dry matter of the grass from the first, second, and third series then contained 14.9, 15.2, and 11.1 per cent of protein, respectively.

These analyses clearly demonstrate the influence of the stage of maturity on the protein content of bluegrass. When the second series was cut as frequently as the first, the grass from the two series contained approximately the

[1]Information to the author.

same amount of protein. When the grass on the second series of plots was allowed to develop for a longer period than that on the first series before it was cut, it contained a smaller percentage of protein. The grass that was allowed to mature, or that which was cut only twice, was lower in protein than that from either of the other series.

CLOSENESS OF GRAZING OR FREQUENCY OF CLIPPING

Excessively heavy grazing is not advisable. On the other hand, if such crops as alfalfa, red clover, bluegrass, and Sudan grass are not kept grazed down sufficiently to cause a maximum production of new growth, they should be clipped one or more times during the season. Unless the rainfall was insufficient to produce new growth, clipping would cause the protein content of the crop to remain at a relatively high level throughout the season.

Data showing the protein content of the dry matter of grazed or clipped bluegrass or permanent pastures at different periods of the season are compiled in Table 3.

RAINFALL

Apparently the difference in the stage of development when the samples are taken is the chief cause of variation in the composition of the dry matter of grass harvested from the same plot at different times. Under reasonably uniform conditions of rainfall, the variation in the composition of closely clipped or grazed bluegrass or mixed pasture at different periods of the season is surprisingly small. The stage of development may be influenced in turn by such factors as closeness of grazing or length of time between clippings and by varying rates of growth, due to differences in temperature and sunlight and particularly to differences in the amount of rainfall or moisture present in the soil.

The yield of dry matter from a given area is probably a fairly reliable indication of the extent of growth and, therefore, of the stage of development when the samples were taken. With few exceptions, the protein content was inversely proportional to the rate or amount of growth.

During August, September, and October, or the period of least variation in the rate of growth of the bluegrass studied by Welton, the protein content of the dry matter remained relatively constant. The report of the investigations carried on by Shutt and others states that the season (1927) was characterized by a remarkably well distributed rainfall, no week being without a shower. Data were given showing the rainfall for two of the three seasons; the studies reported were being carried on in Vermont. With the exceptions of May and August, when it averaged 2.0 and 2.6 inches, respectively, the average monthly precipitation did not fall below 4 inches from May to October, inclusive. The protein content of the dry matter of constantly grazed pastures under such conditions was comparatively uniform.

In the Massachusetts trials the variations in the protein content of the dry matter of pastures which were clipped but not nitrated were not extremely large except for the month of May.

TABLE 3.—Effect of Season on the Protein Content in the Dry Matter of Grazed or Clipped Bluegrass or Permanent Pasture

				April			May			June			July		
				No. of cuttings	Dry matter per cutting	Protein	No. of cuttings	Dry matter per cutting	Protein	No. of cuttings	Dry matter per cutting	Protein	No. of cuttings	Dry matter per cutting	Protein
Welton	Bluegrass Dayton, Ohio	Ohio Bull. 470	Nitrated	.....	.....	.....	2	218	14.1	3	244	13.8	3	123	15.9
			Nonitrate	.....	.....	.....	2	177	10.9	3	168	10.1	3	80	14.4
McClure	Bluegrass Columbus, Ohio	Information to the author	100 lb. N	3	369	23.4*	2	255	19.4	1	363	18.3	3	424	22.2*
			100 lb. N	1	489	24.9*	2	798	17.0	1	397	18.6	1	424	24.3*
			50 lb. N	3	290	21.0*	2	256	18.8	1	294	18.8	3	261	21.3*
			50 lb. N	1	439	21.1*	2	619	15.7	1	400	16.4	1	395	21.1*
			No N	1	220	19.0	2	540	16.5	1	360	18.2	1	229	19.6
Shutt, Hamilton, and Selwyn	Mixed grass Ottawa, Canada	Jour. Agr. Sci. Vol. 18 Part 3		.....	.....	.....	.....	.....	.....	5	....	20.9	4	.....	21.4
				.....	.....	.....	.....	....	.....	2	.....	16.2	2	....	20.1
				.....	.....	.....	.....	.....	.....	1	.....	15.3	1	.....	16.4
Ellenberger	Mixed grass Vermont	Vermont Bull. 295		.....	.....	.....	.....	.....	17.5	.....	....	16.4	.....	.....	17.0
Archibald and Nelson	Massachusetts	J. Am. Soc. Agron. Vol. 21: pp. 686-700	Nitrated	... .	.....	.....	.....	.....	25.6	.. ..	.....	17.5	.....	.....	14.4
			Nonitrate	.....	.....	.. ....	.....	.. ..	18.1	.....	....	11.9	... .	.....	11.2
Hunt and Krauss	Mixed grass Wooster, Ohio	Information to the author		.....	.....	22.5	.....	.....	15.6	.....	.....	10.9	.....	.....	10.6
Hunt and Robison	Bluegrass Wooster, Ohio			.....	.....	.....	2	1046	24.9	1	172	22.5	1	468	20.3
Monroe	Mixed grass Wooster, Ohio	Information to the author		.....	.....	.....	.....	.....	17.3	.....	.....	14.5	.....	.....	18.6

TABLE 3.—Effect of Season on the Protein Content in the Dry Matter of Grazed or Clipped Bluegrass on Permanent Pasture—Continued

				August			September			October		
				No. of cuttings	Dry matter per cutting	Protein	No. of cuttings	Dry matter per cutting	Protein	No. of cuttings	Dry matter per cutting	Protein
Welton	Bluegrass Dayton, Ohio	Ohio Bull. 470	Nitrated	2	120	21.5	3	126	22.0	3	120	22.2
			No nitrate	2	79	19.3	3	75	19.1	3	65	19.0
McClure	Bluegrass Columbus, Ohio	Information to the author	100 lb. N	2	233	19.7†	.....	.....	.....	1	1.0	14.9
			100 lb. N	2	742	15.3†	.....	.....	.....	1	138	14.4
			50 lb. N	2	191	18.4†	.....	.....	.....	1	91	14.8
			50 lb. N	2	583	16.5†	.....	.....	.....	1	177	16.0
			No N	2	446	19.0	.....	.....	.....	1	138	16.1
Shutt, Hamilton, and Selwyn	Mixed grass Ottawa, Canada	Jour. Agr. Sci. Vol. 18 Part 3		2	.....	22.0	2	.....	20.1	.....	.....	.....
				2	.....	19.6	2	.....	18.5	.....	.....	.....
				2	.....	17.8	1	.....	18.5	.....	.....	.....
Ellenberger	Mixed grass Vermont	Vermont Bull. 295		.....	.....	16.9	.....	.....	17.9	.....	.....	17.8
Archibald and Nelson	Massachusetts	J. Am. Soc. Agron. Vol. 21: pp. 686-700	Nitrated	.....	.....	16.2	.....	.....	18.7	.....	.....	13.7
			No nitrate	.....	.....	13.7	.....	.....	.....	.....	.....	13.1
Hunt and Krauss	Mixed grass Wooster, Ohio	Information to the author		.....	.....	.....	.....	.....	12.4	.....	.....	.....
Hunt and Robison	Bluegrass Wooster, Ohio			1	718	25.4	1	1591	23.3	1	280	26.3
Monroe	Mixed grass Wooster, Ohio	Information to the author		.....	.....	20.6	.....	.....	.....	.....	.....	.....

*Nitrogen at the rates of 50 and 25 lb. per acre, respectively, was applied on March 26 and again on June 19.
†Includes a cutting made July 31.

APPLICATION OF NITRATES

The protein content of the dry matter of the grass was increased by the application of a nitrogenous fertilizer. Unless it would be the exception of that on very fertile soils, nitrated pasture also starts to grow earlier in the spring than untreated pasture.

The prompt response from an application of available nitrates, if sufficient moisture is available, and also the relative quickness of the protein content of the grass to drop back after the application has been made are shown by the results of the investigations carried on by McClure.

The plots were clipped June 18 and nitrate was applied the following day. The dry matter of the grass taken from four experimental plots on June 18 contained 18.3, 18.6, 18.8, and 16.4 per cent of protein. That from the same plots 2 weeks later analyzed 24.6, 24.3, 21.6, and 21 per cent, respectively. Twice as much nitrogen was applied to the first two as to the other two plots. Four weeks later the grass from the four plots analyzed 20.1, 16.2, 20.1, and 16.7 per cent of protein, respectively, on a moisture-free basis. The first and third plots were clipped twice, while the second and fourth plots were not clipped between these dates.

FORAGE CROPS COMPARED

ALFALFA

Alfalfa has no superior as a forage crop for pigs. The pigs like it exceptionally well, it is relatively high in protein, minerals, and vitamins, it begins to grow early in the spring and continues until late in the fall, and it produces new growth after being grazed and remains green through the hot, dry weather of late summer. Although care should be taken not to graze it too heavily, particularly if a new seeding is used or one wishes to maintain the stand, few crops equal alfalfa in carrying capacity—that is, in the number of pigs that can be grazed to the acre. Alfalfa will not thrive on an acid or on a poorly drained soil.

Alfalfa was compared with red clover as a forage crop for pigs in 1931 and 1932 and with Dwarf Essex rape in 1929, 1931, and 1932. Summaries of these comparisons are given in Table 4.

In one trial each lot was given a full feed of grain or concentrates twice daily, regardless of the quantity taken by those on some other forage. In the others, in order to bring out the relative value of the forage crops more clearly, the pigs were fed somewhat less than a full feed of grain and each lot was given the same quantity daily a head. Limiting the grain or concentrates somewhat accounts for the rate of gain not being especially high.

Since there were fewer pigs in the groups on alfalfa and since the alfalfa made more growth in midsummer than the clover, the pigs on the alfalfa did not utilize all of the crop that was produced. The amount consumed was estimated to be approximately thirteen-sixteenths of an acre. On this basis, at the prices used and without the more rapid gains being taken into account, the alfalfa was worth $5.94, or 11 per cent, more an acre than the red clover.

As compared with the pigs on Dwarf Essex rape, those on alfalfa gained 15 per cent faster and consumed 7 per cent less feed per unit of gain. Considering only the saving in feed or concentrates per unit of gain, the alfalfa was worth $6.32 an acre more than the rape.

TABLE 4.—Alfalfa Compared with Red Clover and with Rape as a Swine Forage

	With red clover		With rape	
	Alfalfa	Red clover	Alfalfa	Rape
	Shelled corn and tankage			
Acres of forage	0.8	1.0	1.3	1.5
Number of trials	2	2	3	3
Number of pigs	17*	18	25*	26
Initial weight per pig, lb.	56.3	54.4	57.9	56.5
Final weight per pig, lb.	161.0	163.2	205.7	199.8
Average daily gain, lb.	**1.19**	**1.08**	**1.29**	**1.12**
Daily feed per pig, lb.:				
Shelled corn	3.63	3.61	4.23	3.93
Tankage	0.26	0.25	0.27	0.28
Salt	.....	.....	0.005	0.005
Total	3.89	3.86	4.51	4.21
Feed per 100 lb. gain, lb.:				
Shelled corn	307.77	333.83	326.72	349.48
Tankage	21.94	22.81	21.25	24.52
Salt	.....	.....	0.36	0.48
Total	**329.71**	**356.64**	**348.33**	**374.48**
Cost of feed per 100 lb. gain	$ 3.76	$ 4.06	$ 3.95	$ 4.27
Cost of feed and pasture per 100 lb. gain	$ 4.51	$ 4.77	$ 4.60	$ 4.81
Gain per acre of forage, lb.	1991	1963	2643	2483
Returns per acre above feed and pasture charge with gains at 7.5¢ a pound	$ 59.53	$ 53.59	$ 73.04	$ 66.72
Difference per acre in favor of alfalfa	$ 5.94	.....	$ 6.32	.....

*A 63.5-pound pig was taken out after 14 days and a 95.5-pound one died on the 28th day.

Shelled corn 59.5¢ a bu.; tankage $2.25 and salt 75¢ a 100 lb.; alfalfa $16.00, red clover $14.00, and rape $13.48 an acre.

RED CLOVER

Red clover compares favorably with alfalfa in many respects. They are somewhat similar in composition, and both are especially palatable. As a rule, clover cannot be grazed quite as early in the spring as alfalfa, and it produces somewhat less forage to the acre. In seasons of normal rainfall, clover will continue to produce new growth throughout the summer, providing it is sufficiently but not excessively grazed or that it is clipped, so as not to allow it to become too mature. In dry seasons, clover is inclined to dry up in late summer and die; whereas alfalfa remains green. Clover is more often included in the rotations commonly used in Ohio or in the Corn Belt.

Table 5 summarizes seven experiments comparing red clover with Dwarf Essex rape. In the majority of instances the concentrate allowance was limited somewhat, particularly during the early part of the experiments, in order to get the pigs to consume larger amounts of forage and to bring out more clearly the differences in the worth of the crops being compared. For this reason the gains were not as rapid as they would have been otherwise. In the 1916 and 1920 trials, when full feeding was practiced, pigs carried from 46 to 206 pounds in weight made an average gain of 1.44 pounds daily on clover pasture.

ALSIKE

Alsike was compared with red clover in three trials. It is sometimes grown instead of red clover because of its greater tolerance to an acid condi-

the tips after blossoming or has an indeterminate habit of growth. It matures and is of little worth after midsummer. Even when the data were summarized only for the portion of the feeding period that alsike furnished green feed, the red clover not only produced faster gains but also saved sufficient feed per unit of gain to make it worth $10.65 an acre more than the alsike. Inasmuch as red clover furnished grazing for a longer period, this figure does not express the full difference between the worth of the two crops for hog pasture.

TABLE 5.—Red Clover Compared with Rape and with Alsike for Pigs

	With rape		With alsike	
	Red clover	Rape	**Red clover**	Alsike
	Corn, tankage*, and salt			
Acres of forage	3	3	1	1.25
Number of trials	7	7	3	3
Number of pigs	57	58	24	24
Initial weight per pig, lb	64.5	63.8	58.8	58.2
Final weight per pig, lb.	182.2	180.5	138.2	126.1
Average daily gain, lb.	**1.20**	**1.13**	**1.12**	**0.98**
Daily feed per pig, lb.:				
Corn	3.95	3.78	3.60	3.57
Tankage	0.29	0.31	0.26	0.26
Linseed meal*	0.03	0.02	0.04	0.03
Salt	0.002	0.002	0.01	0.01
Total	4.27	4.11	3.91	3.87
Feed per 100 lb. gain, lb.:				
Corn	330.67	334.65	322.86	365.90
Tankage	24.35	27.29	23.22	26.41
Linseed meal	2.03	2.04	3.10	3.28
Salt	0.17	0.20	1.03	1.17
Total	**357.22**	**364.18**	**350.21**	**396.76**
Cost of feed per 100 lb. gain	$ 4.22	$ 4.32	$ 4.09	$ 4.64
Cost of feed and pasture per 100 lb. gain	$ 4.86	$ 4.93	$ 4.82	$ 5.55
Gain per acre of forage, lb.	2212	2205	.....	.....
Returns per acre above feed and pasture charge with gains at 7.5¢ a pound	$ 58.48	$ 56.59	.....	.....

*One-half as much linseed meal as tankage was fed in one trial.

A 115-pound, crooked-legged pig was taken out of a red clover lot in the red clover and rape comparison after 84 days; and two pigs weighing 207 pounds were taken out of a rape lot after 70 days.

A 206-pound pig was taken out of an alsike lot after 70 days and a 124-pound one after 84 days.

Ground corn was fed in two of the clover and rape experiments. It made up 39.3 and 35.7 per cent of the total, respectively.

Shelled corn 59.5¢ a bu.; tankage $2.25, linseed meal $1.50, salt 75¢, and grinding corn 10¢ a 100 lb.; red clover $14.00, rape $13.48, and alsike $12.50 an acre.

DWARF ESSEX RAPE

Dwarf Essex rape is one of the most satisfactory annnual forage crops for pigs. In three comparisons conducted with each crop, rape was found to be worth within $1.32 as much as red clover and within $3.36 as much as alfalfa an acre.

Rape requires a well prepared seedbed and a productive soil similar to that best adapted to the production of corn. Since the young plants are not injured by light frosts, rape may be sown comparatively early in the spring. On the other hand, if sufficient moisture is available, it may be seeded successfully as late as the fore part of July. It will provide grazing when 8 to 10 inches high, or from 7 or 8 weeks after seeding until a heavy freeze comes in the fall. Although it is not a legume, rape is relatively high in protein, as well as in ash or minerals.

By stopping a part of the holes in a grass drill (possibly also in the grass seeding attachment of an ordinary grain drill), rape can be seeded in rows 24 inches apart. This permits cultivating it a time or two, which stimulates growth and aids in keeping down the weeds. From 4 to 6 pounds of seed to the acre are needed when it is broadcasted or drilled solid and from 3.5 to 4.5 pounds when it is drilled in rows. Hence, the cost of seeding is low. Rape is not seriously injured by trampling and produces new growth after being grazed.

Two or more plots are sometimes seeded to rape at the same or different times; these are then pastured alternately, thus allowing one plot to grow while the other is being grazed and possibly thereby increasing the carrying capacity per acre somewhat.

The disadvantages of rape are that it requires a fertile soil for best results, that it is sometimes severely damaged by aphis or plant lice (particularly if it is not on a productive soil), and that it sometimes causes the pigs to blister or sunscald. Although no breed is immune, white and thin-skinned hogs are more likely to sunscald than are colored and thicker-skinned ones. The back and ears are the parts usually affected. Sunscalding seems to be worse during early summer than later. Inasmuch as it is caused by the pigs getting in the rape when it is wet with dew or rain and then getting out into the hot sunshine, scalding is more prevalent in rainy periods than in dry ones. The affected areas may be treated with repeated applications of grease, hard oil, or carbolated petrolatum. Usually, very little trouble from sunscalding is experienced. Even in seasons when it is prevalent, if the pigs are watched closely and treated promptly, the trouble from blistering is not apt to become serious.

The belief sometimes expressed that rape is distasteful to pigs is not substantiated by experimental results and is probably explained by its growing so rapidly under favorable conditions that unless very heavily pastured the pigs at first, or while young, make little discernible headway toward consuming the rape.

CANADIAN FIELD PEAS AND OATS OR RAPE

A mixture of Canadian field peas and oats (seeded at the rates of 2.5 and 1.5 bushels to the acre), one of field peas and rape (seeded, as named, at the rates of 1 bushel and 3 pounds to the acre), and rape alone (seeded at the rate of 4 pounds to the acre) were compared as forage crops for pigs in the test reported in Table 6. A seeding of 1 to 1.5 bushels of field peas and 3 to 4 pecks of oats to the acre would probably have proved more satisfactory than the heavier seeding used.

Eight pigs were turned on each quarter-acre plot 8 weeks after the time of seeding. The forage provided by the mixtures was practically exhausted after being grazed for a period of 6 weeks, at which time it was considered advisable to discontinue the first two lots. Although heavily pastured, the plot seeded to rape alone continued to supply green feed for a period of 15 weeks.

TABLE 6.—Canadian Field Peas with Oats or Rape as a Pasture Crop for Pigs

June 26 to Aug. 7, 1916	Field peas and oats	Field peas and rape	Rape
	Corn 14; tankage 1		
Acres of forage	0.25	0.25	0.25
Number of trials	1	1	1
Number of pigs	8	8	8
Initial weight per pig, lb.	38.7	39.6	39.9
Final weight per pig, lb.	73.2	78.4*	78.4
Average daily gain, lb.	**0.82**	**0.84**	**0.92**
Daily feed per pig, lb.:			
Corn	2.27	2.26	2.26
Tankage	0.16	0.16	0.16
Total	2.43	2.42	2.42
Daily feed per 100 lb. live weight, lb.	4.34	4.10	4.09
eFed per 100 lb. gain, lb.:			
Corn	276.61	269.39	245.81
Tankage	19.76	19.24	17.56
Total	**296.37**	**288.63**	**263.37**
Cost of feed per 100 lb. gain	$ 3.66	$ 3.56	$ 3.25
Cost of feed and pasture per 100 lb. gain	$ 5.16	$ 4.84	$ 4.35

*At the end of the first week a pig in this lot was replaced with one 29 pounds heavier.

Shelled corn 59.5¢ a bu.; tankage $2.25 and grinding corn 10¢ a 100 lb.; field peas and oats $16.48, field peas and rape $14.32, and rape $13.48 an acre.

A charge of $12.00 an acre was made for rental of the land and for preparation of the seedbed. Field peas with oats, 2 bushels per acre at $2.00 a bushel; oats with peas, 1 bu. per acre at 48 cents a bu.; field peas with rape, 1 bu. per acre; rape with field peas, 4 lb. per acre at 8 cents a pound; rape alone, 6 lb. per acre.

Field peas resemble somewhat the taller varieties of garden peas. They produce an abundance of growth. When sown for pasture, some crop which will support them should be seeded with the peas. Rape proved better for this purpose than oats. Because of their tender, succulent character the vines are killed whenever they are trampled upon.

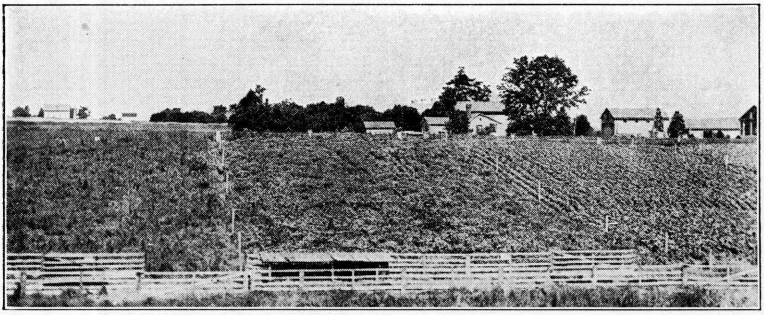

Fig. 1.—Left to right—Canadian field peas and oats; Canadian field peas and Dwarf Essex rape; Dwarf Essex rape

OATS OR SOYBEANS WITH RAPE

Forage crops of rape alone, rape and oats, and rape and soybeans were compared the following year. The oats and the soybeans were sown at the rates of one bushel and one-half bushel to the acre, respectively, and the rape drilled solid on each plot at the rate of 5 pounds to the acre.

TABLE 7.—Oats or Soybeans with Rape as Forages for Pigs

Started July 16, 1917	Rape and oats	Rape and soybeans	Rape
	Corn and tankage		
Acres of forage	0.25	0.25	0.25
Number of trials	1	1	1
Number of pigs	5	5	5
Initial weight per pig, lb.	45.1	44.9	45.2
Final weight per pig, lb.	198.7	197.3	196.8
Average daily gain, lb.	**1.29**	**1.21**	**1.35**
Days required to gain 160 lb., no.	124	132	119
Daily feed per pig, lb.:			
Corn	3.78	3.82	3.81
Tankage	0.20	0.20	0.20
Total	**3.98**	**4.02**	**4.01**
Daily feed per 100 lb. live weight, lb.	3.26	3.32	3.36
Feed per 100 lb. gain, lb.:			
Corn	292.84	315.88	281.27
Tankage	15.49	16.53	14.77
Total	**308.33**	**332.41**	**296.04**
Cost of feed per 100 lb. gain	$ 3.46	$ 3.73	$ 3.32
Cost of feed and pasture per 100 lb. gain	$ 3.88	$ 4.16	$ 3.77

Shelled corn 59.5¢ a bu.; tankage $2.25 a 100 lb.; rape and oats $12.80, rape and soybeans $13.07, and rape $13.48 an acre.

A charge of $12.00 an acre was made for the rental of the land and for preparation of the seedbed. Oats with rape, 1 bu. per acre at 48¢ a bu.; rape with oats, 4 lb. per acre at 8¢ a lb.; soybeans with rape, 3 pecks per acre at 25¢ a peck; rape with soybeans, 4 lb. per acre; rape alone, 6 lb. per acre.

Since they grew less rapidly than the rape, the soybeans were partially smothered out and produced only a meager growth. When the pigs were turned on them the eighth week after the crops were seeded, the oats were more nearly mature than is desirable at the beginning of the grazing period. All plots supplied sufficient forage throughout the test. Rape alone produced faster and slightly greater gains per unit of concentrates fed than did the mixtures. Trials at the Missouri[2] and Pennsylvania[3] Stations likewise indicated rape alone to be superior to a mixture of oats and rape. Oats are satisfactory at first but are of little worth after they begin to head out. When seeded with rape they cause it to produce less forage than when rape is seeded alone. If the mixture is used, 3 pecks of oats to the acre are preferable to a heavier amount. The oats should be sown first and the rape seeded at a shallower depth.

SOYBEAN PASTURE

Soybean pasture is worthy of consideration as a forage crop for pigs under certain conditions. Since the plants are easily frozen, soybeans cannot be seeded in the spring until the danger of frost is past. If an early variety is used, the leaves turn yellow and drop off as the plants approach maturity. If seeded late or if a late maturing variety is used, the plants are killed by the first frost in the fall. Consequently, soybeans furnish grazing for only a relatively short period of time.

[2]Mo. Agr. Exp. Sta. Bull. 247, p. 13.
[3]Pa. Agr. Exp. Sta. Bull. 254, pp. 6 and 9.

Although they often dislike the beans, the foliage of the soybean plant is especially palatable to pigs. Usually the grazing was started in 6 to 8 weeks after the time of seeding. From then until the pods began to fill, the performance of the pigs on soybean forage compared favorably with that of similar pigs on clover or rape pasture. In seven comparisons with pigs carried from an average weight of 65 to one of 195 pounds, those on soybean pasture and those on rape pasture gained 1.20 and 1.19 pounds daily a head, respectively, and, as named, consumed averages of 385 and 384 pounds of feed per 100 pounds of gain produced.

Fig. 2.—Soybean pasture toward the close of the feeding period, or after the plants have lost part of their foliage.

Soybeans differ from alfalfa, red clover, and rape in that they produce little new growth after they are once pastured off; hence, even during the relatively short period grazing is provided, soybean pasture will not carry as many pigs to the acre as the crops just named. In the later trials, if an equal number of pigs were used to the lot, a second, or later, seeding of soybeans was made and the pigs were turned on this seeding when the forage provided by the first seeding was gone. Chiefly because of its shorter season and lower carrying capacity, soybean pasture was worth less an acre than rape.

Soybeans are well adapted to supplying an abundance of palatable green feed during midsummer, or at the time a permanent pasture, like bluegrass, is of little value. They may also serve for growing under conditions which are less favorable for the growing of rape, or for supplying a greater variety of forage.

SUDAN GRASS

Sudan grass is an annual which was introduced into America from Egypt in 1909 by the United States Department of Agriculture. Except that it is finer stemmed and therefore considered more suitable for grazing, it resembles sorghum in appearance and composition and is thought to be the wild, original form of the cultivated sorghums.

Since it will not withstand frost, Sudan grass, like soybeans, provides grazing for only a comparatively short period of time. Although at first it is spindly and meager in appearance, Sudan grass later makes an abundant growth and produces a large amount of forage to the acre. A single plant produces a number of stems. Under average conditions, Sudan grass will attain a height of 4 or 5 feet if it is not clipped. It is said sometimes to grow as high as 10 feet under unusually favorable conditions.

Three comparisons of Sudan grass with other annual forage crops are summarized in Table 8. The Sudan grass was apparently rather palatable to the pigs, particularly when it was clipped from time to time, as was done in one of the trials, to prevent it from heading out and to cause it to produce new growth. The data obtained, however, indicated that its nutritive value was not equal to that of such crops as rape or soybean pasture. It furnished pasture for a larger number of pigs to the acre than soybeans. Thirty pounds or more of seed to the acre were found advisable. In the Ohio trials Sudan grass did not make a showing equal to that made at the Kansas[4] and Nebraska[5] Stations. The Kansas Station reported that Sudan grass was bothered by chinch bugs.

TABLE 8.—Annual Forage Crops for Growing and Fattening Pigs

	1	2	3	4	5
	Rape	**Soybean pasture**	**Sudan grass**	**Sweet clover with spring-seeded winter wheat**	**Peruvian alfalfa with spring-seeded winter wheat**
	Shelled corn and tankage				
Acres of forage	1.5	1.875	1.5	1.5	1.5
Number of trials	3	3	3	3	3
Number of pigs	26	26	26	26	26
Initial weight per pig, lb.	56.5	56.5	56.8	56.3	56.8
Final weight per pig, lb.	199.8	202.4	196.6	199.6	194.7
Average daily gain, lb.	**1.12**	**1.17**	**1.04**	**1.10**	**1.19**
Days required to gain 150 lb., no.	134	128	145	137	126
Daily feed per pig, lb.:					
Shelled corn	3.93	4.20	4.02	4.04	4.01
Tankage	0.28	0.27	0.28	0.28	0.27
Salt	0.005	0.004	0.005	0.006	0.006
Total	4.21	4.47	4.30	4.33	4.29
Daily feed per 100 lb. live weight, lb.	3.29	3.45	3.39	3.38	3.41
Feed per 100 lb. gain, lb.:					
Shelled corn	349.49	359.25	387.56	366.48	337.87
Tankage	24.52	23.36	26.88	25.21	22.87
Salt	0.48	0.37	0.52	0.52	0.49
Total	**374.49**	**382.98**	**414.96**	**392.21**	**361.23**
Cost of feed per 100 lb. gain	$ 4.27	$ 4.35	$ 4.73	$ 4.47	$ 4.11
Cost of feed and pasture per 100 lb. gain	$ 4.81	$ 5.04	$ 5.32	$ 5.07	$ 4.80
Gain per acre of forage, lb.	2483	2023	2284	2303	2241
Returns per acre above feed and pasture charge with gains at 7.5¢ a pound	$ 66.71	$ 49.80	$ 49.82	$ 55.91	$ 60.50

Except in one trial, winter wheat was seeded in the spring with the sweet clover and Peruvian alfalfa.

Two pigs weighing 186 lb. were taken out of the Sudan grass lot in one experiment after 126 days. A 39.5-pound pig was taken out of a sweet clover lot after 56 days, and an 89-pound pig was taken out in another experiment after 28 days. Two pigs weighing 164 lb. were taken out of a Peruvian alfalfa lot in one experiment after 14 days.

Shelled corn 59.5¢ a bu.; tankage $2.25 and salt 75¢ a 100 lb.; rape $13.48, soybean pasture $14.00, Sudan grass $13.50, sweet clover with winter wheat $14.00, Peruvian alfalfa with winter wheat $15.65 an acre.

A charge of $12.00 an acre was made for rental of the land and for preparation of the seedbed. Except for allowing $1.00 an acre for cultivating the rape, this, plus the cost of the seed, made up the pasture charge. Rape, 6 lb. per acre at 8¢ a lb.; Sudan grass, 25 lb. per acre at 6¢ a lb.; sweet clover, 18 lb. per acre at 10¢ a lb.; Peruvian alfalfa, 15 lb. per acre at 21¢ a lb.; wheat, ½ bu. per acre, with the sweet clover and Peruvian alfalfa at $1.00 a bu.

[4]Kan. Agr. Exp. Sta. Cir. 112.
[5]Nebr. Agr. Exp. Sta., Hog Mimeo. Leaflet No. 223.

Stunted or second-growth plants of Johnson grass and of the various members of the sorghum family are said sometimes to develop hydrocyanic or prussic acid in their leaves and to prove poisonous to livestock if they are grazed or fed without curing. H. N. Vinall, of the United States Department of Agriculture, stated in Farmers' Bulletin 1126 that hogs could be pastured on Sudan grass in safety and that horses and sheep were less susceptible to the poison than cattle. Since only three authentic cases of cattle being poisoned by Sudan grass had been called to his attention, he believed Sudan grass could be used with comparative safety but that care should be exercised in pasturing it with cattle, particularly in the northern states. C. M. Herring reported losses of cattle and sheep in California from Johnson grass poisoning, but he stated that complaints of poisoning from the sorghums were rare. In the swine experiments reported herein, no symptoms of poisoning were observed.

Fig. 3.—Unclipped Sudan grass. Clipping it to prevent heading out and to cause new growth would probably increase its value.

SWEET CLOVER

The first year's growth of white sweet clover is another crop which was tried as an annual forage for pigs. It is a biennial, but the second year's growth is too coarse and woody in character to make a suitable pasture for swine. Furthermore, the plants usually mature and die sometime in August, after having gone through a blooming period, which, in Ohio, ordinarily begins about the middle of June and continues for a period of 4 to 6 weeks and immediately following which a large share of the leaves are shed. Yellow sweet clover is finer stemmed but does not produce as much growth the first season and blooms or matures a week or so earlier the second season.

Probably because of its bitter taste, due to the presence of cumarin, the pigs did not like the sweet clover. Neither did they learn to eat it readily, even though the only other forage available was what little foreign material was present, together with what grew around the fence rows.

In the four experiments comparing the two crops, the pigs on rape gained 7 per cent more rapidly and required 5 per cent less feed per unit of gain on the average than did those on sweet clover. The average value of the sweet clover was $6.70 less an acre than that of the rape pasture.

In an experiment carried on in 1925, alfalfa, but no rape, pasture was available with which to compare the sweet clover. Although similar pigs were used, those on the alfalfa gained 41 per cent faster and required only 66 per cent as much feed per unit of gain as did those on sweet clover.

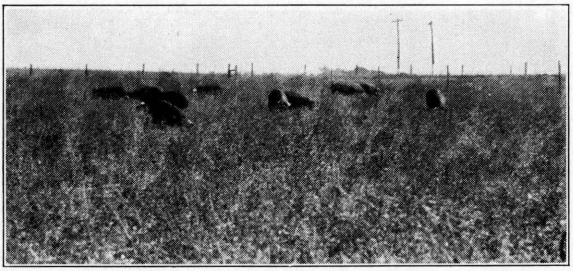

Fig. 4.—The first year's growth of white biennial sweet clover. Sweet clover was distasteful to the pigs

If seeded early, the sweet clover has an opportunity to get more of a start before the pigs are turned on it. Early seedings are also bothered less with weeds than later ones. Weeds often become a serious problem in sweet clover planted without a nurse crop if it is not seeded until rather late in the spring. One of the most satisfactory stands secured for the experiments was sown early in March on ground that had been plowed and prepared in the fall. Because of the greater erosion of ground left loose and bare during the winter, such a practice would not be adaptable to rolling land.

SPRING-SEEDED WINTER WHEAT WITH SWEET CLOVER

Beginning in 1931, spring seedings of winter wheat with April, or relatively late, seedings of sweet clover were tried. When sown in the spring, winter wheat does not head out but remains recumbent in its habit of growth. Besides aiding in the control of weeds, it thus provides excellent pasture during the early part of the grazing period, while the sweet clover is becoming established. The wheat then ordinarily dies out during the latter part of July. In these trials, the wheat was seeded at the rate of 2 to 2.5 pecks per acre. When it is used as a pasture for hogs the first season, a rather heavy seeding of sweet clover, or from 15 to 18 pounds to the acre, is advisable.

No direct comparisons of sweet clover alone and of the combination of sweet clover and spring-sown winter wheat were made, but the effect of seeding winter wheat with the sweet clover in improving the quality of the forage is shown indirectly, by the data presented in Table 9 comparing both with rape. Wheat with the sweet clover reduced the quantity of feed required per 100 pounds of gain from 5 per cent to only 1 per cent more than that required on rape pasture and increased the rapidity of growth from 6.5 per cent less to the same rate as that of the pigs on rape.

TABLE 9.—Showing the Effect of Seeding Winter Wheat with Sweet Clover in the Spring

	Sweet clover	Rape	Sweet clover with winter wheat*	Rape
	Corn and tankage			
Acres of forage	2	2	1	1
Number of trials	4	4	2	2
Number of pigs	40	38	18	18
Initial weight per pig, lb.	59.8	61.1	53.9	53.9
Final weight per pig, lb.	183.4	184.4	193.1	195.4
Average daily gain, lb.	**1.16**	**1.24**	**1.05**	**1.05**
Days required to gain 150 lb., no.	130	121	143	143
Daily feed per pig, lb.:				
Corn	4.28	4.34	3.73	3.68
Tankage	0.30	0.31	0.26	0.26
Minerals	0.04	0.05	.....	.....
Total	4.62	4.70	3.99	3.94
Daily feed per 100 lb. live weight, lb.	3.80	3.83	3.23	3.16
Feed per 100 lb. gain, lb.:				
Corn	368.54	350.13	354.58	349.27
Tankage	26.00	24.93	24.50	24.60
Minerals	3.83	4.03	.....	.....
Total	**398.37**	**379.09**	**379.08**	**373.87**
Cost of feed per 100 lb. gain	$ 4.76	$ 4.56	$ 4.32	$ 4.26
Cost of feed and pasture per 100 lb. gain	$ 5.37	$ 5.14	$ 4.94	$ 4.79
Gain per acre of forage, lb.	2282	2343	2248	2543
Returns per acre above feed and pasture charge with gains at 7.5¢ a pound	$ 48.67	$ 55.37	$ 57.52	$ 68.80

*Winter wheat sown in the spring at the same time as the sweet clover.

Two pigs weighing 92 lb. each were taken out of a sweet clover lot after 14 days and an 80.5-lb. one after 28 days.

Shelled corn was fed in two and ground corn in two of the four experiments comparing sweet clover and rape. Shelled corn made up 42.5 and ground corn 57.5 per cent of the total fed the pigs on sweet clover. Shelled and ground corn made up 34.4 and 65.6 per cent, respectively, of the total fed the lots on rape.

Shelled corn was fed in both experiments comparing rape with a combination of sweet clover and spring-sown winter wheat. An 89-lb. pig in one experiment was taken out of the sweet clover and wheat lot after 28 days and a 39.5-lb. pig, in the other experiment, after 56 days.

Minerals were fed in two of the experiments and the salt consumed recorded in another of the experiments comparing sweet clover and rape. The mineral mixture in one of the experiments was made up of salt 18.4, limestone 36.8, spent bone black 36.8, iron oxide 2.97, Glauber's salts 5, and potassium iodide 0.03. Special steamed bone meal was substituted for the spent bone black in the other experiment.

Shelled corn 59.5¢ a bu.; tankage $2.25, grinding corn 10¢, salt 75¢, limestone 50¢, spent bone black $1.50, special steamed bone meal $1.80, Glauber's salts $3.00, and iron oxide $4.00 a 100 lb.; potassium iodide $4.00 a lb. and mixture of minerals and salt as fed 1.3¢ a lb.; sweet clover $13.80, rape $13.48, sweet clover with spring-sown winter wheat $14.00 an acre.

PERUVIAN ALFALFA AS AN ANNUAL FORAGE

After sweet clover was found to be distasteful to pigs and to show a lower value than rape, seeding alfalfa in the spring and pasturing it the first year (that is, using it in the same way as sweet clover) was tried. Hairy Peruvian alfalfa, which was reported by the Agronomy Department to be the most rapid growing variety of those tested, was selected for the purpose. This variety is commonly grown in the Southwest but winterkills in the North where the temperature falls below 10 above zero. Inasmuch as it was wanted for pasturing the first season, winterkilling was not a serious objection.

Three representative experiments in which Peruvian alfalfa was compared with other annual forage crops are summarized in Table 8. Winter wheat was seeded with both the sweet clover and Peruvian alfalfa in two of the three

trials. The pigs on the Peruvian alfalfa required less feed per unit of gain in two of the trials and made slightly faster gains in each of the three than did those on the sweet clover.

A summary including three experiments in which Peruvian alfalfa alone and two in which a mixture of Peruvian alfalfa and spring-seeded winter wheat were compared with rape showed no difference in either the average rate of growth or the average amount of feed required per unit of gain produced.

SPRING-SEEDED WINTER WHEAT WITH PERUVIAN ALFALFA

The mixture of spring-seeded winter wheat and Peruvian alfalfa made a more favorable showing in comparison with the rape than did the Peruvian alfalfa alone. Although it was capable of carrying only about 90 per cent as many pigs to the acre as rape, an advantage in favor of the mixture was that it had no tendency to cause sunscalding. Alfalfa being a legume is another advantage in favor of the mixture.

BLUEGRASS

Since bluegrass forms a sod, few crops can be grazed as early in the spring as bluegrass. If a nitrate fertilizer is applied or if the ground is naturally fertile, bluegrass will start to grow shortly after the ground thaws out in the spring. In its early stages of growth bluegrass, like the cereals, is relatively low in fiber and compares favorably with the legumes in its protein and mineral content. As the plants mature their nitrogen content gradually decreases and they become more woody and fibrous in character. During the hot, dry weather of midsummer bluegrass is dry, woody, and unpalatable and of little value as a forage for hogs. After producing new growth in the fall

TABLE 10.—Bluegrass Compared with Red Clover for Pigs

	Bluegrass	Red clover
	Shelled corn and tankage	
Acres of forage	0.5	0.5
Number of trials	1	1
Number of pigs	8	8
Initial weight per pig, lb.	42.3	43.0
Final weight per pig, lb.	196.1	203.9
Average daily gain, lb.	**0.93**	**1.15**
Days required to gain 160 lb., no.	172	140
Daily feed per pig, lb.:		
Corn	3.41	3.85
Tankage	0.27	0.28
Total	3.68	4.13
Daily feed per 100 lb. live weight, lb.	3.09	3.34
Feed per 100 lb. gain, lb.:		
Corn	366.19	335.44
Tankage	29.21	23.91
Total	**395.40**	**359.35**
Cost of feed per 100 lb. gain	$ 4.55	$ 4.10
Cost of feed and pasture per 100 lb. gain	$ 5.37	$ 4.65
Gain per acre of forage, lb.	2191	2573
Returns per acre above feed and pasture charge, with gains at 7.5¢ a pound	$ 46.68	$ 73.41

A 60.5-pound pig was taken out of the bluegrass lot after 98 days.

Shelled corn 59.5¢ a bu.; tankage $2.25 a 100 lb.; red clover $14.00 and bluegrass $9.00 an acre.

bluegrass again provides valuable forage for pigs. In seasons of sufficient rainfall perhaps clipping the grass from time to time to renew its growth would prolong the time it was suitable for grazing and increase its worth. There are areas on many farms that can be utilized to advantage as permanent bluegrass pasture for swine or other livestock but that are not adapted to the growing of cultivated crops.

Aside from its low value during July and August, a disadvantage of bluegrass, particularly for young pigs, is the likelihood of its becoming contaminated with worm eggs if hogs are kept on it for several years in succession.

Table 10 reports an experiment comparing bluegrass and red clover for growing and fattening pigs which were placed on feed June 21 and continued until they averaged approximately 200 pounds in weight. As previously mentioned, this includes the period of year when bluegrass shows a relatively low value.

In less fertile regions, where crops like alfalfa, red clover, and rape cannot be grown successfully, soybean pasture for midsummer and bluegrass for spring and fall should make a reasonably satisfactory combination. Bluegrass is also of value at various times for the breeding herd.

RYE OR WHEAT

Crops like rye and wheat can often be used to advantage in the spring or fall for sows and suckling pigs but, because of coming at the time of year they do, were not experimented with as forage crops for growing and fattening pigs.

PROTEIN SUPPLEMENTS FOR PIGS ON PASTURE

FACTORS INFLUENCING THE AMOUNT OF SUPPLEMENT NEEDED

Since young pigs require a larger percentage of protein in their ration than older ones, the age of the pigs, as well as the proportions of forage and grain consumed and the protein content of the forage, influence the percentage of protein supplement, if any, needed by pigs on pasture. The relative price of the protein concentrate to the grain portion of the ration is still another factor affecting the amount of supplement it is advisable to use.

Age of pigs.—Table 11 summarizes 14 experiments in which corn alone was compared with corn and tankage for pigs that were running on pasture and were being given a full feed of grain or concentrates. In four trials on rape pasture and two on red clover, the average initial weights ranged from 35 to 54 pounds. In the other trials, including four on red clover and four on rape pasture, the average weights of the pigs at the beginning of the experiments ranged from 60 to 80 pounds. The data for the two weight classifications are summarized separately.

Including tankage in the rations of the pigs which were started at the lighter weights, to the average extent of 8.7 per cent of their total feed, increased the rate of growth 24 per cent, or shortened the feeding period 27 days. Aside from producing faster gains, each pound of tankage consumed saved 2.7 pounds of corn.

TABLE 11.—Comparison of Corn Alone and of Corn and Tankage for Pigs of Different Ages on Clover or Rape Pasture

	Younger pigs		Older pigs	
	Corn	Corn Tankage	Corn	Corn Tankage
Acres of pasture, approximate	2.75	2.5	3.25	3.0
Number of trials	6	6	8	8
Number of pigs	50	51	55	57
Initial weight per pig, lb.	45.0	44.2	67.1	65.8
Final weight per pig, lb.	174.2	172.4	193.0	195.2
Average daily gain, lb.	**1.04**	**1.29**	**1.22**	**1.40**
Days required to gain 150 lb., no.	144	117	123	107
Daily feed per pig, lb.:				
Corn	4.19	4.15	4.82	4.88
Tankage	.....	0.40	.....	0.28
Salt	0.01	0.01	0.01	0.01
Total	4.20	4.56	4.83	5.17
Daily feed per 100 lb. live weight, lb.	3.83	4.21	3.72	3.96
Feed per 100 lb. gain, lb.:				
Corn	404.47	322.57	395.50	348.06
Tankage	.....	30.79	.....	19.74
Salt	0.59	0.41	1.18	1.06
Total	**405.06**	**353.77**	**396.68**	**368.86**
Cost of feed per 100 lb. gain	$ 4.65	$ 4.40	$ 4.55	$ 4.46
Cost of feed and pasture per 100 lb. gain	$ 5.26	$ 4.93	$ 5.21	$ 5.04
Pounds of corn replaced by each pound of tankage, lb.	.....	2.66	.....	2.40

Younger pigs: Three taken out of corn alone lot; two in one experiment after 28 days, at a weight of 55.5 lb., and another in a different experiment after 105 days, at a weight of 84.5 lb. Two were taken out of the corn and tankage lot, one, weighing 53.5 lb., after 20 days and in a different experiment another, weighing 116 lb., after 56 days.

Older pigs: A 100-lb. pig was taken out of a corn alone lot after 100 days. A 103.5-lb. pig was taken out of a corn and tankage lot after 42 days, and a 92-lb. pig out of the same lot after 56 days.

Shelled corn was fed in one and ground corn in five of the experiments with the younger pigs. The shelled corn made up 15 per cent of the total in the corn alone rations and 15.5 per cent of the total in the corn and tankage rations. Shelled corn was also fed in one of the experiments with the older pigs and made up 10.9 per cent of the total in the corn and tankage rations and 14.5 per cent of the total in the corn alone rations.

Shelled corn 59.5¢ a bu.; tankage $2.25, salt 75¢, and grinding corn 10¢ a 100 lb.; clover (0.75 acre for the younger pigs and 1 acre for the older ones) $14.00 an acre; rape (the remainder) $13.48 an acre.

Feeding tankage to the pigs which averaged approximately 65 pounds in weight at the beginning of the feeding period increased the rapidity of the gains 14.7 per cent, or enabled them to be marketed 9 days earlier than similar pigs given no tankage. The tankage made up an average of 5.4 per cent of their total feed, and each pound consumed saved 2.4 pounds of corn.

In an effort to make up for the deficiency in the concentrate portion of their ration, the pigs fed corn and salt or corn and minerals practically always ate a noticeably larger amount of forage than those fed corn and tankage or corn and some other high-protein feed.

Quantity of grain fed.—Although the amount of concentrates consumed varies considerably, full-fed pigs, or those given all the concentrates they care for, usually take around 4 pounds of feed daily for each 100 pounds of their live weight. Limiting or restricting the grain causes the pigs to utilize a larger amount of forage. Since good quality forage is relatively high in protein, an increase in its consumption should reduce the need for a high-protein feed in the concentrate portion of the ration.

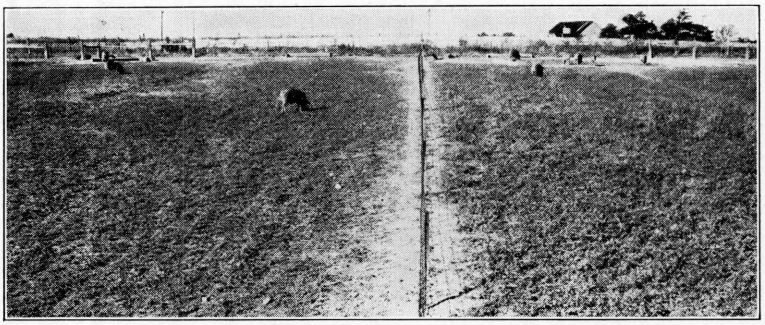

Fig. 5.—Red clover pasture. The plot on the left carrying pigs fed only corn and salt is more closely grazed than the one on the right carrying an equal number of pigs fed corn, tankage, and minerals.

Four experiments comparing corn and corn and tankage for pigs on rape pasture given a limited amount of concentrates, or approximately 3 pounds for each 100 pounds of their live weight, are summarized in Table 12.

TABLE 12.—Corn Versus Corn and Tankage for Pigs Fed Limited Rations on Rape Pasture

	Ground corn	Ground corn Tankage
Acres of forage	1.0	1.125
Number of experiments	4	4
Number of pigs	24	24
Initial weight per pig, lb.	50	51
Final weight per pig, lb.	154	157
Average daily gain, lb.	**0.95**	**1.09**
Days required to gain 150 lb., no.	158	138
Daily feed per pig, lb.:		
Corn	3.01	3.13
Tankage	.....	0.23
Total	3.01	3.36
Daily feed per 100 lb. live weight, lb.	**2.94**	**3.23**
Feed per 100 lb. gain, lb.:		
Corn	314.84	287.80
Tankage	.....	21.21
Total	314.84	309.01
Cost of feed per 100 lb. gain	$ 3.66	$ 3.82
Cost of feed and pasture per 100 lb. gain	$ 4.35	$ 4.30
Corn replaced by each pound of tankage, lb.	.....	1.27

A 60.5-lb. pig was taken out of a corn alone lot after 7 days.

Corn 59.5¢ a bu.; tankage $2.25 and grinding corn 10¢ a 100 lb.; rape pasture $13.48 an acre.

The pigs were carried from approximately 50 to 155 pounds in weight. Those getting tankage gained 15 per cent faster than those without it, but each pound of tankage consumed replaced only 1.3 pounds of corn. At the relative prices usually existing, the corn saved would not pay for the cost of the tankage[6].

[6]For data on feeding tankage to shotes on pasture given a limited amount of concentrates see Page 46.

Protein content of forage.—As was previously pointed out, the protein content of a forage crop decreases as the plants approach maturity. Consequently, pigs grazing on forage consisting largely of new growth require a smaller amount of supplement than similar pigs on a like crop that is more nearly mature. Likewise, a smaller percentage of supplement is needed with a kind of forage that is high in protein than with one that is low in protein.

COMPARATIVE RATIOS OF SUPPLEMENT TO CORN FOR DRY-LOT AND PASTURE FEEDING

Because of both the changing composition of the forage and the variation in the relative amounts of grain and forage consumed, the percentage of supplement needed in the ration by pigs on forage cannot be estimated as closely as that needed by pigs that are not on pasture.

In representative experiments on clover pasture, which were conducted in 1916 and 1920, full-fed spring pigs carried from 46 to 206 pounds in weight consumed an average of 5 pounds of feed daily a head. If it is assumed that an acre of clover will provide sufficient forage for 20 pigs for 112 days and that the green feed eaten in this time is equivalent to 2800 pounds (after being reduced to a moisture content of 10 per cent), the average consumption would be 1.25 pounds daily, or approximately 20 per cent of the total feed. If 1.5 pounds daily, or a total of 3360 pounds of forage, having a moisture content of 10 per cent were consumed, it would be equivalent to approximately 30 per cent of the total ration.

The second column of Table 13 shows the medium and wide nutritive ratios recommended in Morrison's feeding standards for pigs of the four different weight classifications given in the first column. The third column gives the percentage of tankage needed in the ration to balance corn for dry-lot feeding according to these standards. The fourth column shows the approximate percentages of total protein in the rations given in the third column.

According to an analysis reported in Bulletin 175 of the Kentucky Agricultural Experiment Station, the dry matter in young clover 11 inches in height contained 22.99 per cent of protein. Hunt of the Ohio Experiment Station found the dry matter of a sample of clover taken June 2 to contain 16.9 per cent of protein. As given in Henry and Morrison's "Feeds and Feeding", the average protein content, on a moisture-free basis, of 36 samples of clover taken during the blooming period was 14.91 per cent and that of seven samples of rowen, or second-growth clover, was 15.4 per cent. When calculated on a moisture basis of 10 per cent, these analyses as named would be equivalent to 20.7, 15.2, 13.4, and 17.1 per cent of protein.

The ratios of corn to tankage to clover required to provide rations containing the same percentages of total protein as the dry-lot rations are shown in the three succeeding columns in the table. These are given for clovers containing three different levels of protein, with each making up 20 and 30 per cent of the total feed. From the data obtained, the amounts of supplement needed by pigs on clover as compared with that needed by pigs in dry lot were computed and are shown in the last three columns of the table.

The figures presented emphasize the importance of using forage of good quality from the standpoint of reducing the amount of protein supplement needed.

TABLE 13.—Relative Amounts of Protein Supplement Needed by Pigs in Dry Lot and on Clover Pasture

Weight of pigs (Lb.)		Nutritive ratios recommended	Tankage needed to balance corn (Pct.)	Total protein content of ration (Pct.)	Ratios of corn to tankage to clover needed to supply pigs on pasture a ration containing the same percentage of total protein			Pounds of tankage in each 100 pounds of concentrates			Amount of supplement needed by pigs on clover compared with that needed by pigs in dry lot (Pct.)		
					21% protein clover	18% protein clover	15% protein clover	21% protein clover	18% protein clover	15% protein clover	21% protein clover	18% protein clover	15% protein clover
With clover, reduced to a 10 per cent moisture basis, making up 20 per cent of the feed													
30– 50	Medium	1 : 4.25	16.25	17.6	68.4 : 11.6 : 20	67.2 : 12.8 : 20	66.0 : 14.0 : 20	14.5	16.0	17.5	89.2	98.5	107.7
50–100	Medium	1 : 5.30	11.25	15.1	73.3 : 6.7 : 20	72.1 : 7.9 : 20	70.9 : 9.1 : 20	8.4	9.9	11.4	74.4	87.8	101.1
100–150	Medium	1 : 5.90	9.30	14.1	75.3 : 4.7 : 20	74.1 : 5.9 : 20	72.9 : 7.1 : 20	5.9	7.4	8.9	63.2	79.3	95.4
150–200	Medium	1 : 6.60	7.10	13.0	77.5 : 2.5 : 20	76.3 : 3.7 : 20	75.1 : 4.9 : 20	3.1	4.6	6.1	44.0	65.1	86.3
30– 50	Wide	1 : 4.5	14.8	17.6	69.8 : 10.2 : 20	68.6 : 11.4 : 20	67.4 : 12.6 : 20	12.7	14.2	15.7	86.1	96.3	106.4
50–100	Wide	1 : 5.6	10.1	15.1	74.5 : 5.5 : 20	73.3 : 6.7 : 20	72.1 : 7.9 : 20	6.9	8.4	9.9	68.1	82.9	97.8
100–150	Wide	1 : 6.2	8.2	14.1	76.5 : 3.5 : 20	75.3 : 4.7 : 20	74.1 : 5.9 : 20	4.4	5.9	7.4	53.4	71.6	89.9
150–200	Wide	1 : 7.0	6.0	13.0	78.6 : 1.4 : 20	77.5 : 2.5 : 20	76.3 : 3.7 : 20	1.7	3.1	4.6	29.2	52.1	77.1
With clover, reduced to a 10 per cent moisture basis, making up 30 per cent of the feed													
30– 50	Medium	1 : 4.25	16.25	17.6	60.7 : 9.3 : 30	58.9 : 11.1 : 30	57.1 : 12.9 : 30	13.3	15.9	18.4	81.8	97.6	113.4
50–100	Medium	1 : 5.30	11.25	15.1	65.6 : 4.4 : 30	63.8 : 6.2 : 30	62.0 : 8.0 : 30	6.3	8.9	11.4	55.9	78.7	101.6
100–150	Medium	1 : 5.90	9.30	14.1	67.6 : 2.4 : 30	65.8 : 4.2 : 30	64.0 : 6.0 : 30	3.4	6.0	8.6	36.9	64.5	92.2
150–200	Medium	1 : 6.60	7.10	13.0	69.7 : 0.3 : 30	68.0 : 2.0 : 30	66.2 : 3.8 : 30	0.4	2.9	5.4	6.0	40.2	76.5
30– 50	Wide	1 : 4.5	14.8	16.9	62.0 : 8.0 : 30	60.3 : 9.7 : 30	58.5 : 11.5 : 30	11.4	13.9	16.4	77.2	93.6	111.0
50–100	Wide	1 : 5.6	10.1	14.5	66.8 : 3.2 : 30	65.0 : 5.0 : 30	63.2 : 6.8 : 30	4.6	7.1	9.7	45.3	70.7	96.2
100–150	Wide	1 : 6.2	8.2	13.5	68.8 : 1.2 : 30	67.0 : 3.0 : 30	65.2 : 4.8 : 30	1.7	4.3	6.9	20.9	52.3	83.6
150–200	Wide	1 : 7.0	6.0	12.4	70.0 : 0.0 : 30	69.2 : 0.8 : 30	67.4 : 2.6 : 30	.....	1.1	3.7	.....	19.0	61.9

Since green feeds carry proteins which presumably are of excellent quality and since they are also relatively rich in vitamins and minerals, pigs on good pasture probably require no more protein than is supplied by the wider rations. Apparently, however, unless they are grazing on young growth (which consequently is particularly rich in protein), it would seldom be advisable to give pigs that are under 100 pounds in weight less than 70 per cent as much supplement as would be given similar pigs in dry lot. Depending on the quality of the forage, pigs between 100 and 150 pounds in weight probably need from 50 to 70 per cent as much supplement as similar pigs in dry lot. Little or no supplement is needed by pigs weighing 150 pounds or more and running on excellent forage. Perhaps on poorer forage it would be advisable to use up to at least 50 per cent as much supplement as is desirable under dry-lot conditions.

COMPARISON OF SUPPLEMENTS FOR PIGS ON PASTURE

Table 14 gives the results of experiments comparing various protein supplements with tankage for pigs on pasture. Their values, on a percentage basis, in relation to that of tankage (as determined by the amount of tankage and grain, expressed in tankage equivalent, replaced by them per unit of gain produced) are shown in the last column of the table. The values would be affected by changes in the relative prices of corn and tankage and are intended only as approximations. It is also recognized that additional data on some of the feeds are needed before the figures can be taken as a very dependable guide to the relative worth of the various supplements considered.

The comparative worth of different supplements for the feeding of pigs on forage is not necessarily the same as that for the feeding of pigs in dry lot or vice versa. Inasmuch as green feed tends to correct any protein, mineral, or vitamin deficiency in the concentrate portion of the ration, pasture minimizes the differences in the worth of the various protein supplements. Furthermore, some supplements which would prove of relatively low value for dry-lot feeding because of such factors as being unpalatable, too laxative in their effect, or slightly toxic might prove reasonably satisfactory when mixed with the carbonaceous feed and fed in the smaller amounts required by pigs on pasture.

No minerals other than salt were included in the rations containing linseed meal, buckwheat middlings, or corn germ meal. Minerals would possibly have enabled them to have made a more favorable showing.

MINERALS FOR PIGS ON PASTURE

With supplements of plant origin.—In the experiments reported in Table 15 minerals were beneficial with corn and soybeans or corn and soybean oilmeal for pigs running on rape pasture and given a full feed of concentrates twice daily. When fed with corn and soybeans, each pound of minerals, other than salt, replaced 5.1 pounds of corn and 0.3 pound of soybeans. Taking the figures for the lot getting minerals with soybean oilmeal which required the greater amount of feed per unit of gain, each pound of minerals fed, exclusive of the salt, saved 3.4 pounds of corn and 0.8 pound of soybean oilmeal. Presumably minerals would likewise prove beneficial with other protein supplements of plant origin for full-fed pigs even though they were running on forage.

TABLE 14.—Value of Various Supplements as Compared with Tankage for Pigs on Pasture

	No. of experiments	No. of pigs	Initial weight per pig	Final weight per pig	Av. daily gain	Daily feed per pig	Feed per 100 lb. gain				Relative rate of gain with tankage as 100%	Supplement equal to one pound of tankage†	Relative value of supplement with tankage as 100%
							Corn	Supplement	Minerals	Total			
			Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Pct.*	*Lb.*	*Pct.*
Tankage	4	32	62	191	1.22	4.6	362.5	15.8	.....	378.3	.....	.....	.....
Skimmed milk	4	33	62	196	1.26	4.8*	330.8	443.7	.....	379.6*	103	14.02	7
Tankage	6	60	66	188	1.40	4.6	305.5	25.5	1.1	332.1	.....	.....	.....
Fish meal	6	61	67	188	1.39	4.6	308.0	24.0	0.9	332.9	99	0.98	102
Tankage	6	60	68	214	1.61	5.7	330.0	24.5	1.0	355.5	.....	.....	.....
Dry-rendered tankage‡	6	60	70	224	1.67	5.9	328.6	24.4	1.0	353.9	104	0.89	112
Tankage	3	17	58	219	1.39	5.0	342.5	20.1	.....	362.6	.....	.....	.....
Linseed meal	3	17	58	215	1.34	5.1	338.4	41.1	.....	379.5§	96	1.86	54
Tankage	4	36	54	218	1.30	5.1	360.7	24.2	4.9	389.8	.....	.....	.....
Soybeans	4	36	54	209	1.14	4.7	355.0	48.4	8.4	411.8	88	2.09	48
Tankage	3	26	56	205	1.36	5.1	344.1	22.6	5.2	371.9	.....	.....	.....
Cooked soybeans	3	26	56	209	1.42	5.2	320.5	40.8	5.7	367.0	104	1.21	83
Tankage	2	15	54	199	1.44	5.1	332.3	20.2	3.9	356.4	.....	.....	.....
Soybean oilmeal	2	15	54	205	1.54	5.5	324.7	26.4	3.7	354.8	107	1.09	92
Tankage	1	5	67	234	1.49	5.7	362.7	19.1	.....	381.8	.....	.....	.....
Buckwheat middlings	1	5	67	237	1.52	5.9	331.1	55.2	.....	386.3	102	1.58	63
Tankage	1	6	60	205	1.38	4.9	333.9	17.6	.....	351.5	.....	.....	.....
Corn germ meal	1	6	60	201	1.26	4.7	283.0	94.3	.....	377.3	91	2.19	46

*With the skimmed milk reduced to a 10 per cent moisture basis.

†Or its equivalent, with 2 lb. of corn and 1.125 lb. of minerals figured as equal to 1 pound of tankage

‡Dry-rendered tankage or meat and bone scrap. It contained an average of 56 per cent and the steam-rendered tankage an average of 60 per cent of protein.

§A part of this difference may have been due to no minerals, other than salt, having been fed with the linseed meal.

The four trials comparing skimmed milk and tankage for pigs on pasture include two Wisconsin trials on oat, pea, and rape pasture, one Nebraska trial on alfalfa, and one Ohio trial on bluegrass pasture.

The six trials comparing fish meal and tankage for pigs on pasture include two Pennsylvania, two Iowa, one Washington, and one Ohio trials. The Washington trial was on pea and the others on rape forage.

Four of the experiments comparing dry-rendered tankage, or meat and bone scraps, with steam-rendered tankage were conducted by the Indiana Station (1929, 1931, and 1933) on clover or alfalfa pasture; one by the Nebraska Station (1926) on Sudan grass; and one by the Ohio Station (1930) on rape pasture.

The other comparisons reported in the table were made at the Ohio Experiment Station.

TABLE 15.—Minerals with Soybeans and Soybean Oilmeal for Pigs on Rape Pasture

	Soybeans		Soybean oilmeal		
	Corn Soybeans Salt	Corn Soybeans **Minerals**	Corn Soybean oilmeal Salt	Corn Soybean oilmeal **Minerals** (1)	Corn Soybean oilmeal **Minerals** (2)
Acres of forage	1	1	0.5	0.5	0.5
Number of experiments	2	2	1	1	1
Number of pigs	17	17*	10	10	10
Initial weight per pig, lb.	54.0	54.0	45.2	45.2	45.1
Final weight per pig, lb.	199.9	200.2	196.2	212.1	217.8
Average daily gain, lb.	**1.23**	**1.27**	**1.23**	**1.32**	**1.37**
Days required to gain 150 lb., no.	122	118	122	114	110
Daily feed per pig, lb.:					
Corn	4.46	4.30	4.11	4.30	4.42
Supplement	0.52	0.52	0.37	0.37	0.37
Salt or minerals	0.03	0.09	0.02	0.10	0.08
Total	5.01	4.91	4.50	4.77	4.87
Feed per 100 lb. gain, lb.:					
Corn	364.09	339.45	335.33	324.99	322.26
Supplement	42.20	40.84	30.22	27.86	26.92
Salt or minerals	2.64	7.18	1.79	7.55	5.83
Total	**408.93**	**387.47**	**367.34**	**360.40**	**355.01**
Cost of feed per 100 lb. gain	$ 4.67	$ 4.40	$ 4.06	$ 3.99	$ 3.91
Cost of feed and pasture per 100 lb. gain	$ 5.22	$ 4.98	$ 4.49	$ 4.40	$ 4.30

*A 104-lb. pig was taken out after being on feed for 64 days and a 110-lb. one after being on feed for 70 days.

In one of the soybean experiments the minerals consisted of salt 1 and limestone 2; in the other they consisted of equal parts of salt, limestone, and special steamed bone meal. In the soybean oilmeal experiment minerals (1)=salt 1, limestone 2, and raw bone meal 2; minerals (2)=salt 1, limestone 2, spent bone black 2.

Shelled corn was used in the soybean oilmeal experiment. Shelled corn was used in one and ground corn in the other soybean experiment. Ground corn represented 59 per cent of the total in the no-mineral lots and 54.6 per cent of the total in the mineral lots. In the soybean experiment the salt and limestone mixture made up 54.2 per cent of the total minerals.

Shelled corn 59.5¢ and soybeans 75¢ a bu.; soybean oilmeal $1.60, salt 75¢, limestone 50¢, special steamed bone meal $1.80, raw bone meal $2.25, spent bone black $1.50, and grinding corn and soybeans 10¢ a 100 lb.; rape pasture $13.48 an acre.

With tankage.—Tankage is higher in ash than are the supplements of plant origin. Since it is also higher in protein, it makes up a smaller percentage of the ration. Consequently, the mineral content of the ration is not increased proportionately when tankage is fed. Table 16 summarizes two experiments on clover and one on rape pasture in which a mineral mixture was fed, both with corn alone and with corn and tankage. In one of the experiments the minerals were made up of salt 19.37, limestone 38.8, special steamed bone meal 38.8, iron oxide 2.8, anhydrous copper sulfate 0.2, and potassium iodide 0.03. A similar mixture, except that it contained 5 per cent of Glauber's salts (sodium sulfate) and no copper sulfate, was used in the other two trials.

In each of the three trials the corn was ground and the minerals or the tankage and minerals mixed with it in order to compel the pigs to take the various feeds in definite proportions. The minerals constituted 2.5 per cent of the total feed when fed with corn alone. When fed with corn and tankage, they were used at the rate of 2.5 per cent of the total feed in one trial and at the rate of 1.5 per cent in the other two. Since older pigs require less protein than younger ones, the amount of tankage in the ration was reduced when an average weight of 120 or 125 pounds was reached. The pigs were full fed

twice daily in one and self fed in two of the three experiments. They consumed an average of approximately 4 pounds of feed daily for each 100 pounds of their live weight.

TABLE 16.—Feeding Minerals with Corn and with Corn and Tankage for Full-fed Pigs on Forage

	Ground corn	Ground corn Minerals	Ground corn Tankage	Ground corn Tankage Minerals
Acres of pasture	1.5	1.5	1.5	1.5
Number of trials	3	3	3	3
Number of pigs	30	30*	30	30
Initial weight per pig, lb.	66.9	66.9	66.2	67.2
Final weight per pig, lb.	207.2	207.8	205.4	211.2
Average daily gain, lb.	**1.23**	**1.39**	**1.44**	**1.54**
Days required to gain 150 lb., no.	123	108	105	98
Daily feed per pig, lb.:				
Corn	5.35	5.40	4.96	5.12
Tankage	.....	.....	0.36	0.35
Salt or minerals	0.02	0.14	0.03	0.10
Total	5.37	5.54	5.35	5.57
Daily feed per 100 lb. live weight, lb.	3.92	4.04	3.94	4.00
Feed per 100 lb. gain, lb.:				
Corn	435.95	389.20	345.37	331.49
Tankage	.....	.....	25.13	22.89
Salt or minerals	2.19	9.98	1.87	6.68
Total	**438.14**	**399.18**	**372.37**	**361.06**
Cost of feed per 100 lb. gain	$ 5.08	$ 4.66	$ 4 59	$ 4.46
Cost of feed and pasture per 100 lb. gain	$ 5.58	$ 5.17	$ 5.09	$ 4.94

*In one experiment a 53-pound and a 62.5-pound one were taken out of the lot on the 14th day and a 71.5-pound one put in on the 28th day.

In two of the experiments the minerals consisted of salt 18.4, limestone 36.8, special steamed bone meal 36.8, iron oxide 2.97, Glauber's salts 5, and potassium iodide 0.03. In the third the minerals were salt 19.37, limestone 38.8, special steamed bone meal 38.8, iron oxide 2.8, anhydrous copper sulfate 0.2, and potassium iodide 0.03. The latter made up 33.9 per cent of the minerals for Lot 2 and 47.3 per cent of the minerals for Lot 4. Its cost was $1.43 and that of the other $1.37 a 100 pounds.

Clover pasture was used in two experiments and rape pasture in one.

Shelled corn 59.5¢ a bu.; tankage $2.25, salt 75¢, and grinding corn 10¢ a 100 lb.; clover $14.00 and rape $13.48 an acre.

If they are not rung, pigs may do some rooting when the ground is soft, regardless of the way they are fed. Those given a protein supplement or minerals or both with corn did much less rooting than those fed only corn and salt as the concentrate portion of their ration. The damage done by them in any of the experiments was negligible. As will be seen from Figure 6, the pigs on the corn and salt ration sometimes did an excessive amount of rooting.

With corn alone.—When added to corn alone, each pound of minerals fed, exclusive of the salt, saved 5.9 pounds of corn. When added to corn and tankage, each pound of minerals, exclusive of the salt, saved 2.6 pounds of corn and 0.4 pound of tankage. The pigs having minerals were ready for market 7 days earlier, on the average, than those without minerals when tankage was fed and 15 days earlier when no tankage was fed.

In 1933, a somewhat similar test was conducted. The pigs were self fed. Shelled corn instead of ground corn was used. This necessitated feeding the minerals or the mixture of tankage and minerals, separately, so that the proportion of minerals or of minerals and tankage to corn could not be controlled.

For the first 3 weeks of the experiment the pigs were kept on mixed clover pasture which had previously been grazed by sows and suckling and weanling pigs and, hence, was rather short. They were then transferred to rape pasture where, by moving those without a protein supplement to different lots toward the close of the feeding period, plenty of forage was provided for each lot until the experiment was completed. The minerals and tankage for the fourth lot were mixed in the ratio of 1:4, by weight.

Fig. 6.—The ration fed influences the amount of rooting done.

Photographs taken October 30, 1930, when rape was short after having been grazed for 19 weeks.

Upper—Plot carrying pigs fed only corn and salt.

Lower—Plot carrying pigs fed corn and minerals. Plots carrying pigs fed corn and a protein concentrate or corn, a protein concentrate, and minerals were in similar condition.

TABLE 17.—Minerals for Pasture-fed Pigs (1933) which Consumed Less Than a Full Feed of Concentrates

	Shelled corn Salt	Shelled corn Minerals	Shelled corn Tankage Salt	Shelled corn Tankage Minerals
Acres of pasture	1	1	1	1
Number of trials	1	1	1	1
Number of pigs	20	20*	20	20
Initial weight per pig, lb.	50.3	50.2	49.9	50.2
Final weight per pig, lb.	206.6	203.1	213.8	204.7
Average daily gain, lb.	**0.97**	**0.94**	**1.23**	**1.16**
Days required to gain 150 lb., no.	155	160	122	130
Daily feed per pig, lb.:				
Shelled corn	3.74	3.57	3.80	3.69
Tankage	.....	.....	0.22	0.10
Salt or minerals	0.03	0.04	0.03	0.03
Total	3.77	3.61	4.05	3.82
Daily feed per 100 lb. live weight, lb.	**2.93**	**2.85**	**3.07**	**3.00**
Feed per 100 lb. gain, lb.:				
Shelled corn	384.74	380.43	308.25	317.82
Tankage	.....	.....	18.27	9.02
Salt or minerals	3.33	4.23	2.07	2.26
Total	**388.07**	**384.66**	**328.59**	**329.10**
Cost of feed per 100 lb. gain	$ 4.12	$ 4.12	$ 3.71	$ 3.62
Cost of feed and pasture per 100 lb. gain	$ 4.55	$ 4.57	$ 4.12	$ 4.06

*A 125-lb. pig was taken out after being on feed for 111 days.

Minerals—Salt 19.37, limestone 38.8, special steamed bone meal 38.8, iron oxide 2.8, anhydrous copper sulfate 0.2, and potassium iodide 0.03.

Shelled corn 59.5¢ a bu.; tankage $2.25, salt 75¢, and minerals $1.43 a 100 lb.; rape pasture $13.48 an acre.

TABLE 18.—Minerals for Limited-fed Pigs on Clover Pasture

	Ground corn Tankage Salt	Ground corn Tankage Minerals
Acres of forage	0.5	0.5
Number of trials	1	1
Number of pigs	8	8
Initial weight per pig, lb.	73.8	73.7
Final weight per pig, lb.	204.8	203.2
Average daily gain, lb.	**0.94**	**0.93**
Days required to gain 150 lb.	160	162
Daily feed per pig, lb.:		
Corn	3.06	3.04
Tankage	0.16	0.14
Salt or minerals	0.02	0.05
Total	3.23	3.23
Daily feed per 100 lb. live weight, lb.	**2.32**	**2.33**
Feed per 100 lb. gain, lb.:		
Corn	327.04	328.97
Tankage	16.58	15.02
Salt or minerals	1.73	5.24
Total	**345.35**	**349.23**
Cost of feed per 100 lb. gain	$ 3.88	$ 3.83
Cost of feed and pasture per 100 lb. gain	$ 4.74	$ 4.69

Minerals—Salt 18.4, limestone 36.8, special steamed bone meal 36.8, iron oxide 2.97, Glauber's salts 5, and potassium iodide 0.03.

Shelled corn 59.5¢ a bu.; tankage $2.25, salt 75¢, limestone 50¢, bone meal $1.80, iron oxide $4.00, Glauber's salts $3.00, and grinding corn 10¢ a 100 lb.; potassium iodide $4.00 a lb.; clover pasture $14.00 an acre.

Neither the lot receiving tankage without minerals nor the one receiving the mixture of tankage and minerals ate much supplement, especially during the early part of the experiment. Lot 2 failed to eat much more of the mineral mixture than Lot 1 ate of salt.

For some reason, although they were self fed, the pigs consumed only about three-fourths as much total concentrates daily as is usually taken by full-fed pigs. Both the larger consumption of forage, as a consequence, and the low consumption of minerals or of minerals and tankage minimized the effect of the minerals.

With limited rations.—Inasmuch as forage is relatively high in minerals, getting the pigs to eat more of it by restricting the grain or concentrate allowance would be expected to reduce the need for adding minerals to the ration.

Table 18 gives the results of an experiment in which corn and tankage, with and without minerals (except salt), were fed to pigs on clover pasture and the amount fed was limited to approximately 2.3 pounds daily for each 100 pounds of live weight. Under these conditions, nothing whatever was gained from adding minerals, other than salt, to the ration.

SINGLE AND MIXED PROTEIN CONCENTRATES FOR PIGS ON PASTURE

LINSEED MEAL OR COTTONSEED MEAL WITH TANKAGE

For dry-lot feeding, combinations of certain high-protein feeds have proved more effective than either, when it is used alone as a supplement to corn. Table 19 summarizes four experiments in which mixtures of tankage and linseed meal and two in which mixtures of tankage and cottonseed meal were compared with tankage alone for supplementing corn and minerals for pigs on rape pasture. Ground oats were substituted for a part of the corn in one of the experiments in which linseed meal was fed. In none of the six experiments did the combination of protein feeds prove more effective than the single supplement.

MIXTURE OF SIX PROTEIN CONCENTRATES COMPARED WITH A SINGLE ONE

In 1932 a mixture of tankage 36, fish meal 14, dried skimmed milk 8, cottonseed meal 15, soybean oilmeal 15, linseed meal 8, and minerals 4 and one of tankage and minerals were compared as supplements to corn for pigs on clover pasture. Ground corn was used and all of the feeds were mixed and self fed. The pigs averaged approximately 73 pounds at the beginning and 218 pounds at the close of the test.

In their respective rations, the tankage was reduced from 8.8 to 6 per cent and the mixed supplement from 11.5 to 8 per cent of the total feed when the pigs averaged approximately 120 pounds in weight. Two and one-half per cent of minerals, or an average of 1 pound to every 2.9 pounds of tankage, was included in the ration containing tankage. The minerals in the ration containing the mixed supplement made up an average of only 0.4 per cent of the total feed.

The average daily gains were 1.60 and 1.47 pounds and the feed consumed per 100 pounds of gain 376 and 375, respectively.

TABLE 19.—Adding Linseed and Cottonseed Meal to Tankage for Pigs on Pasture

	Linseed meal		Cottonseed meal	
	Corn* Tankage Minerals	Corn* Tankage Linseed meal Minerals	Corn Tankage Minerals	Corn Tankage Cottonseed meal Minerals
Acres of forage	2	2	1	1
Number of trials	4	4	2	2
Number of pigs	39	39	20	20
Initial weight per pig, lb.	62.7	62.4	60.7	60.8
Final weight per pig, lb.	201.9	204.4	203.6	204.5
Average daily gain, lb.	**1.43**	**1.37**	**1.51**	**1.47**
Daily feed per pig, lb.:				
Ground corn	4.80	4.93	5.07	5.07
Ground oats	0.30	0.29	.....	.....
Tankage	0.31	0.25	0.33	0.21
Linseed or cottonseed meal	.....	0.16	.....	0.21
Minerals	0.06	0.07	0.07	0.08
Total	5.47	5.70	5.47	5.57
Feed per 100 lb. gain, lb.:				
Ground corn	336.78	358.82	335.80	345.85
Ground oats	20.72	21.18	.....	.....
Tankage	21.56	18.12	21.73	14.44
Linseed or cottonseed meal	.....	11.36	.....	14.44
Minerals	4.59	5.33	4.50	5.31
Total	383.65	414.81	362.03	380.04
Cost of feed per 100 lb. gain	$ 4.70	$ 5.06	$ 4.45	$ 4.63
Cost of feed and pasture per 100 lb. gain	$ 5.20	$ 5.57	$ 4.93	$ 5.10

*Oats were used as a partial substitute for corn in one trial.

In one trial spent bone black instead of special steamed bone meal was fed. It made up 31.72 per cent of the bone product fed in the four comparisons. Otherwise the minerals consisted of salt 18.4, limestone 36.8, special steamed bone meal 36.8, iron oxide 2.97, Glauber's salts 5, and potassium iodide 0.03.

Shelled corn 59.5¢ and oats 32¢ a bu.; tankage $2.25, linseed meal $1.50, cottonseed meal $1.50, salt 75¢, limestone 50¢, special steamed bone meal $1.80, spent bone black $1.50, iron oxide $4.00, Glauber's salts $3.00, grinding corn 10¢, and grinding oats 15¢ a 100 lb.; potassium iodide $4.00 a lb.

Except that dried buttermilk was substituted for the dried skimmed milk, a mixture of the same feeds in the ratio of 30:12:8:12:12:6:20 was tried for feeding to pigs on rape pasture in 1933. Twenty pigs, which were carried from approximately 50 to 205 pounds in weight, were used in each lot. Shelled corn and whatever supplement they received were self fed separately to each lot. The supplement of minerals and tankage was mixed in the ratio of 1:4. Neither lot took much supplemental feed, particularly during the early part of the experiment. The tankage and minerals averaged 2.74 and 0.69 per cent, respectively, of the total feed consumed by the lot having access to a mixture of the two. Of the total feed consumed by the other group, 5.34 per cent consisted of the high-protein feeds and 1.34 per cent of the minerals mixed with them.

The two groups gained 1.16 and 1.18 pounds daily a head and required 329 and 331 pounds of feed per 100 pounds of gain produced, respectively. Each group took approximately 3 pounds of feed daily for each 100 pounds of their live weight, or only about three-fourths as much as is usually consumed by full-fed pigs. Their failure to gain more rapidly was doubtless due to their low consumption of total feed and of supplement.

TABLE 20.—Comparison of Tankage and Mixed Protein for Pigs on Forage

	Corn Tankage Minerals	Corn Mixed protein Minerals
Number of experiments	2	2
Number of pigs	30	30
Initial weight per pig, lb.	57.7	57.9
Final weight per pig, lb.	209.2	211.5
Average daily gain, lb.	**1.27**	**1.26**
Days required to gain 150 lb., no.	118	120
Daily feed per pig, lb.:		
Corn	4.13	4.01
Supplement	0.19	0.29
Minerals	0.06	0.04
Total	4.38	4.34
Daily feed per 100 lb. live weight, lb.	3.28	3.26
Feed per 100 lb. gain, lb.:		
Corn	324.68	318.26
Supplement	14.77	22.99
Minerals	4.54	3.47
Total	**343.99**	**344.72**
Cost of feed per 100 lb. gain	$ 3.96	$ 4.04
Cost of feed and pasture per 100 lb. gain	$ 4.41	$ 4.48

In one trial the mixed protein consisted of tankage 36, fish meal 14, dried skimmed milk 8, cottonseed meal 15, soybean oilmeal 15, linseed meal 8, and minerals 4. In the other it consisted of tankage 30, fish meal 12, dried buttermilk 8, cottonseed meal 12, soybean oilmeal 12, linseed meal 6, and minerals 20. The former made up 47.6 and the latter 52.4 per cent of the total supplement.

Minerals—Salt 19.37, limestone 38.8, special steamed bone meal 38.8, iron oxide 2.8, anhydrous copper sulfate 0.2, and potassium iodide 0.03.

In one trial ground corn and in the other shelled corn was used. There were 20 pigs to the lot when shelled corn was fed. The ground corn made up 33.44 and 33.92 per cent of the total amount fed the pigs in Lots 1 and 2, respectively.

Clover pasture was used in the experiment with 10 pigs to the lot and rape pasture in the experiment with 20 pigs to the lot.

Shelled corn 59.5¢ a bu.; tankage $2.25, fish meal $2.50, dried skimmed milk or dried buttermilk $4.00, cottonseed meal $1.50, soybean oilmeal $1.60, linseed meal $1.50, and grinding corn 10¢ a 100 lb.; salt 0.75¢, limestone 0.5¢, special steamed bone meal 1.8¢, iron oxide 4¢, anhydrous copper sulfate 80¢, and potassium iodide $4.00 a lb. At these prices the mineral mixture cost 1.43¢; the first mixed supplement, including minerals, 2.12¢; and the second mixed supplement, including the minerals, 2.04¢ a pound, respectively.

DIFFERENT AMOUNTS OF GRAIN FOR PIGS ON FORAGE

LIMITING THE GRAIN THROUGHOUT THE FEEDING PERIOD

Pigs on pasture that are fed a limited amount of grain or concentrates eat more forage and require fewer pounds of concentrates per unit of gain but gain more slowly than similar pigs that are self fed or that are given all the grain they care for twice daily. Although it varies considerably and decreases somewhat as the pigs become heavier, the feed consumed by full-fed pigs averages approximately 4 pounds daily for each 100 pounds of their live weight.

Table 21 summarizes seven experiments in which full feeding and limited feeding of pigs on pasture were compared. Red clover was used in four and rape in three of the trials. The time of starting the experiments ranged from June 14 to July 10, and the average initial weights of the pigs were from 52 to 73 pounds. The limited-fed pigs were given approximately 2.5 pounds of feed daily for each 100 pounds of their live weight, or about five-eighths of a full feed. Except in one instance, the full-fed pigs were self fed, and the corn and supplement were placed in separate compartments of the feeders. In each experiment the ration consisted of corn, tankage, and salt.

TABLE 21.—Full- and Limited-feeding of Pigs on Pasture

	Limited feed entire time	Full feed entire time
Pigs per acre of pasture, no.	**14**	**20**
Number of trials	7	7
Number of pigs at start*	63	72
Average days of age at start	90	91
Initial weight per pig, lb.	60.1	60.1
Final weight per pig, lb.	204.0	206.2
Average daily gain, lb.	**0.93**	**1.43**
Days required to gain 150 lb., no.	162	105
Daily feed per pig, lb.:		
Corn	2.80	4.89
Tankage	0.17	0.32
Salt	0.01	0.02
Total	2.98	5.23
Daily feed per 100 lb. live weight, lb.	**2.26**	**3.92**
Feed per 100 lb. gain, lb.:		
Corn	313.53	343.55
Tankage	18.98	22.21
Salt	1.10	1.21
Total	**333.61**	**366.97**
Percentage of new corn that could be used	55	0
Cost of feed per 100 lb. gain	$ 4.03	$ 4.86
Cost of feed and pasture per 100 lb. gain	$ 4.73	$ 5.38
Average date of starting experiments	June 21	June 21
Gain of 150 lb. per pig made by	Nov. 30	Oct. 4
Week of year	48	40
Selling price a 100 lb.	$ 6.99	$ 7.97
Returns per 100 lb. gain, above feed and pasture costs and loss in value of original weight	$ 1.82	$ 2.59

*Six pigs were removed from the limited- and four from the full-fed lots. The average numbers in the lots for the full time were 58.66 and 69, respectively. The pig days and total pounds of gain were 8926 and 8312.2 for the limited-fed lots and 6972 and 9935.3 for the full-fed lots, respectively.

If it is assumed that the limited-fed pigs were fed new corn from the time of their first weigh day on or after September 15, 45 per cent of that utilized by them would have been old and 55 per cent new corn. The limited-fed pigs utilized approximately 1.89 acres of clover and 2.36 acres of rape. Of their total corn 48.43 per cent was ground.

The full-fed pigs utilized approximately 1.75 acres of clover and 2 acres of rape. Of their corn, all old, 48.75 per cent was ground.

New corn 56¢ and old corn 68.04¢ a bu., or 21.5 per cent more. Tankage $2.25, salt 75¢, and grinding corn 10¢ a 100 pounds. Clover pasture $14.00 and rape pasture $13.48 an acre.

Since the feed required per unit of gain increases as pigs become heavier, the limited- and the full-fed pigs were carried to approximately the same average final weights. Because of the increase in the consumption of forage when the grain allowance is restricted, usually fewer pigs were placed in the limited- than in the full-fed lots. In 1931, when this was not done, the limited-fed pigs ran short of forage during the early part of September. They were placed on rape plots previously grazed by other pigs and on October 20 were transferred to bluegrass pasture for the remaining 6 weeks of the feeding period. Although an abundance of bluegrass was available, it was apparently less valuable than the rape. While on the rape, for the 6 weeks preceding the change, and while on the bluegrass, their feed requirement per unit of gain was 9.3 per cent lower and 8.4 per cent higher, respectively, than that of the full-fed pigs when of corresponding weights. For the entire test they consumed within 3.3 per cent as much feed per unit of gain as the full-fed pigs. In the other six experiments, the limited-fed pigs consumed from 20 to 82 pounds, or from 5.4 to 20.1 per cent less of feed per unit of gain than the full-fed pigs. In the six trials, the average daily gains and the feed consumed per 100 pounds of gain by the full- and the limited-fed pigs were 1.44 and 0.97 pounds and 373 and 327 pounds, respectively.

Although, in some instances, they were not ready for market until late in the season, the limited-fed pigs were kept on the forage plots and finished there rather than being placed in dry lots during the latter part of the feeding period.

The full-fed pigs were ready for market 57 days earlier, on the average, than those given a limited amount of grain. Hog prices decline in the fall of the year as the number being marketed increases. Figure 7 shows the general average weekly price of hogs at Chicago for 25 years (1904 to 1933, inclusive, except for the 5 years from 1916 to 1920, when prices were abnormal because of the war).

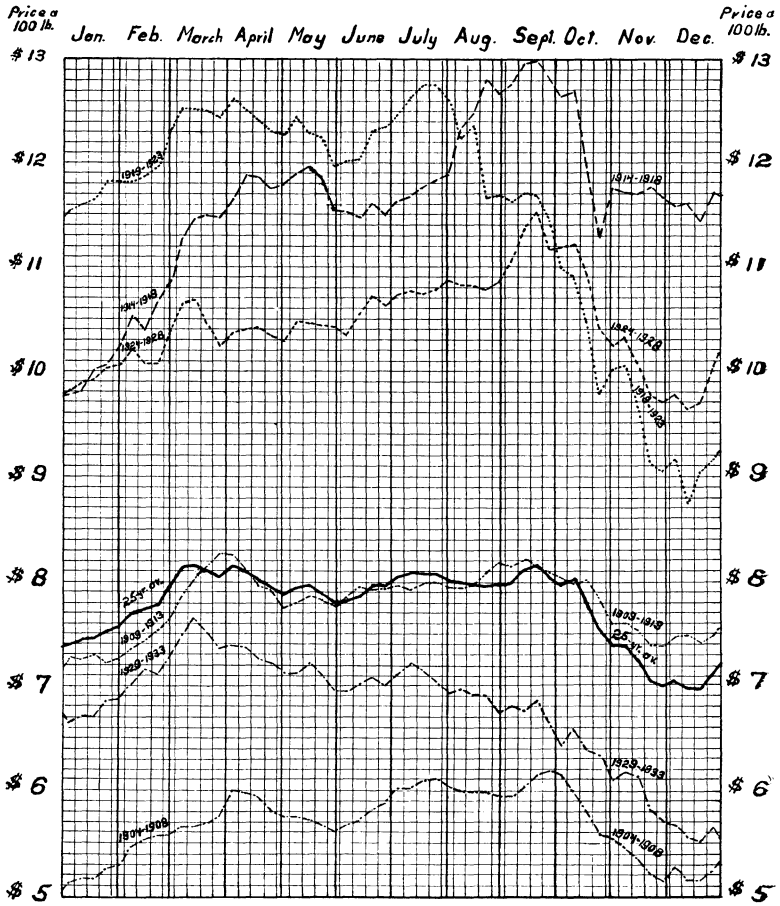

Fig. 7.—General weekly average price of hogs at Chicago

There was only one exception (1909) in the 30-year period from 1904 to 1933 when the price of hogs was as high in November and December as in September and October. Usually the decline began between the thirty-seventh and forty-first week and continued until between the forty-seventh and fifty-

first week, more often the latter. With the exception referred to, it ranged from 6.3 to 45.5 per cent. For the 25 years, the curve for which is shown in Figure 7, the average price of hogs declined from an average of $8.14 a 100 pounds for the thirty-eighth week to $6.97 for the fiftieth and fifty-first week of the year, or a total of 14.4 per cent from September to December. The extent of this seasonal decline in the fall of the year has shown no tendency to decrease within recent years as compared with earlier periods. For 1932 and 1933, the extent of the decline amounted to 28.5 and 33.3 per cent, respectively. During periods when the yearly average price of hogs is falling, it is usually greater than during periods when the yearly average price of hogs is rising. When the general price trend of hogs was downward, hogs usually sold at a higher price in March or April than in the fall of the year. When it was advancing, hogs usually sold higher in late summer or early fall than at any other time of year.

The average starting date of the experiments reported in Table 21 was June 21. The pigs used averaged 91 days of age at the beginning of the experiments. This would make their average farrowing date March 22. The average dates on which the full-fed pigs and those given a limited amount of grain had made a gain of 150 pounds each, or were ready for market, were October 4 and November 30, respectively. As named, they were thus ready for market during the fortieth and forty-eighth weeks of the year. The 25-year average price of hogs at Chicago, as shown in Figure 7 for these weeks, is used as the selling price in computing the relative returns from the two methods of feeding.

Since the full-fed pigs were well finished, they would probably have sold at top prices. When the limited-fed pigs reached a similar weight, they were larger framed, rougher coated, and thinner (that is, not so well finished) and would probably not have brought top prices. Hence, the figures used in computing the returns favor the limited- rather than the full-fed pigs.

Spring pigs that are fed a limited amount of grain can be finished on new corn. On the other hand, spring pigs that are full fed with the idea of fitting them for an early market must be finished largely on old or higher priced corn.

In the United States the average farm price of corn in December for the period from 1904 to 1933, inclusive, with the years from 1916 to 1920 excluded, was 58.5 cents a bushel. Figures giving the price received by farmers in other months for the first 4 years of this period are not available. A summary for the remaining 21 of the 25 years, however, shows that the average price of corn for the months of June, July, August, and September was 18.2, 21.9, 24.6, and 21.4 per cent higher, respectively, than that for the succeeding December, when, because of the effect of the new crop just harvested, it was lower than during any other month. Chicago average prices of No. 3 yellow corn for the same years were 11.3, 16.8, 20.3, and 15.6 per cent higher in the 4 months, as named, than in December. For the 4 months from June to September, inclusive, the farm price averaged 21.5 per cent and the Chicago price 16.0 per cent higher, respectively, than the December price.

In determining the relative profitableness of the two methods of feeding, the full-fed pigs were assumed to be finished on old corn, which was valued at 68 cents a bushel, or 21.5 per cent higher than the new corn. They were not ready for market until after the limited-fed pigs were assumed to have been changed to new corn but the intervening period was considered too short to justify the change. The limited-fed pigs were assumed to have been switched

from old to new corn at the time of their first weekly or biweekly weight after September 15, when 45 per cent of the total amount consumed by them would have been old corn valued at 68 cents and 55 per cent would have been new corn valued at 56 cents a bushel.

If one were buying instead of raising corn to feed, he would be likely to purchase it, if possible, at a time of year when the price was not at its peak. With lower priced old corn the difference in favor of the full-fed pigs would be still greater.

The lower selling price received for the limited-fed pigs applies not only to the gains in live weight made during the experimental period but also to the weight of the pigs at the time the experiments were started. Hence, in comparing the relative returns from the two methods of feeding, the loss in the market value sustained on the original weight of the limited-fed pigs, due to the delayed time of marketing, was taken into account.

If the clover pasture is figured at $14.00 and the rape pasture at $13.48 an acre and the prices given for corn and hogs are used, the returns per 100 pounds of gain in live weight, above the feed and pasture costs and the loss in value on the original weight of the limited-fed pigs, are shown in Table 21. The returns from the full-fed pigs were 77 cents greater on each 100 pounds of gain than were those from the limited-fed pigs.

LIMITED FEEDING AT FIRST FOLLOWED BY FULL FEEDING LATER

Nine experiments were conducted in which a plan of limiting the concentrates during the early part of the feeding period, or until the pigs averaged approximately 125 pounds in weight, and full feeding them thereafter was compared with one of full feeding for the entire time. Clover pasture was used in three and rape in six of the trials. The ration consisted of corn, tankage, and salt.

The dates on which the tests were started ranged from June 14 to July 10, the mean being June 21. The pigs averaged 88 days in age and 55 pounds in weight at the start of the experiments. Those on the limited ration were given approximately 2.5 pounds of feed daily for each 100 pounds of their live weight. During this period they ate more forage but required 20.8 per cent less concentrates per unit of gain than did the full-fed pigs, while of similar weights.

No new corn was fed in the experiments, but the plan of limiting the feed at first and full feeding later is somewhat similar to the practice sometimes followed of carrying spring pigs along on a limited amount of feed until new corn is available and full feeding thereafter. It is also equivalent to dividing the pig's life after weaning into a growing and a fattening period. In full feeding, on the other hand, the growing and fattening processes are combined.

If it is assumed that the pigs given the limited ration at first were changed to new corn on their first weekly or biweekly weigh day after September 15, they would have utilized 44 per cent of old and 56 per cent of new corn. Although the pigs that were full fed for the entire time were not ready for market until October 9, in making the calculations they were assumed to have been fed entirely on old corn.

The pigs that were given a limited ration at first and a full feed later reached a similar market weight by October 30, or during the forty-fourth week of the year. The general weekly average price of hogs at Chicago for

the 25-year period from 1904 to 1933, inclusive, with the 5 years from 1916 to 1920 omitted, was $8.03 a 100 pounds for the forty-first week and $7.39 for the forty-fourth week.

TABLE 22.—Limited Feeding Until Pigs Average 125 Pounds in Weight and Full Feeding Thereafter

	Period of limited feeding		Period of full feeding		Entire time	
	1	2	1	2	1	2
	Limited grain allowance	Full grain allowance	Full feeding following limited feeding	Full feeding following full feeding	Limited feed at first, full feed later	Full feed entire time
Pigs per acre of pasture					15	20
Number of trials	9	9	9	9	9	9
Number of pigs at start*	88	99	84	95	88	99
Average days of age at start, no.					87	88
Initial weight per pig, lb.	54.9	54.1	124.0	125.3	54.9	54.1
Final weight per pig, lb.	124.0	125.3	208.9	208.9	208.9	208.9
Average daily gain, lb.	0.81	1.06	1.75	1.79	**1.14**	**1.35**
Days required to gain 150 lb., no.					132	111
Daily feed per pig, lb.:						
Corn	2.09	3.50	6.44	6.36	3.64	4.67
Tankage	0.18	0.27	0.32	0.40	0.23	0.32
Salt	0.002	0.004	0.007	0.008	0.004	0.005
Total	2.27	3.77	6.77	6.77	3.88	5.00
Daily feed per 100 lb. live weight, lb.	2.54	4.20	4.07	4.05	**2.94**	**3.80**
Feed per 100 lb. gain, lb.:						
Corn	258.87	329.64	367.76	354.32	318.50	345.53
Tankage	22.51	25.46	18.37	22.43	20.24	24.01
Salt	0.31	0.36	0.41	0.42	0.36	0.39
Total	281.69	355.46	386.54	377.17	**339.10**	**369.93**
Per cent of new corn that could be used					56.3	
Cost of feed per 100 lb. gain					$ 4.08	$ 4.91
Cost of feed and pasture per 100 lb. gain					$ 4.66	$ 5.35
Average date of starting experiments	June 21	June 21	Sept. 14	Aug. 26	June 21	June 21
Gain of 150 lb. made by					Oct. 30	Oct. 9
Week of year					44th	41st
Selling price per 100 lb.					$ 7.39	$ 8.03
Returns per 100 lb. gain above feed and pasture costs and loss in value of original weight					$ 2.49	$ 2.68

*Five pigs were removed from the lots given a limited feed at first and four from the lots full fed for the entire time. The average total numbers in the lots for the full time of the experiments were 84.27 and 96, respectively. The pig days and total pounds of gain were 11,256 and 12,871, respectively, for the first named and 10,933 and 14,771.7 for the last named group.

If it is assumed that the pigs given a limited ration at first were fed new corn from the time of their first weekly or biweekly weight on or after September 15, 43.7 per cent of that utilized by them would have been old and 56.3 per cent new corn. The pigs given a limited ration at first utilized approximately 1.375 acres of clover and 4.125 acres of rape. Of their corn, 42.1 per cent was ground.

The pigs that were full fed for the entire time utilized approximately 1.22 acres of clover and 3.555 acres of rape. Of their corn, all old, 49.2 per cent was ground.

New corn 56¢ and old corn 68.04¢ a bu., or 21.5 per cent more. Tankage $2.25, salt 75¢, and grinding corn 10¢ a 100 pounds; clover pasture $14.00 and rape pasture $13.48 an acre.

Limiting the ration at first and full feeding later resulted in lowering the feed and pasture cost 69 cents for each 100 pounds of gain produced. Even when the lower selling price of the pigs fed in this way was taken into account and the loss in value on their weight at the start was deducted, the returns

over the cost of the feed and pasture showed a difference of 19 cents for each 100 pounds of gain produced in favor of the plan of full feeding for the entire time. If the calculations are made on a basis of the full-fed pigs having likewise received new corn after September 15, the difference in their favor is found to amount to 40 cents for each 100 pounds of gain produced.

Such factors as the length of time a limited ration is fed, the extent to which it is limited, the time of farrowing, and the ability of the pigs to make rapid growth influence the relative returns to be secured from the two plans of feeding.

Pigs farrowed 2 weeks earlier, or by March 11, and gaining at the same rate would have been ready for market by the thirty-ninth and forty-second weeks of the year when the weekly average prices were $8.03 and $7.80 a 100 pounds, respectively. New corn would have made up only 42 per cent of that fed the pigs given a limited ration at first, but, because of the smaller difference in selling price, limiting the feed at first and full feeding later would have resulted in 18 cents greater returns for each 100 pounds of gain produced than full feeding for the entire time.

The influence of the rate of growth upon the relative returns from the two methods of feeding is shown by the results obtained in three of the nine experiments. In these three, the average initial and final weights were 56 and 208 pounds, respectively, or practically the same as those for the nine. During the period of limited feeding, the pigs were given 2.53 pounds of feed daily for each 100 pounds of their live weight, or no more than the average fed in the nine experiments during the same period. In the three trials, however, the self-, or full-fed, pigs made an average gain of 1.53 pounds and those given a limited feed at first and a full feed later an average gain of 1.25 pounds, daily. The two groups, as named, consumed 351 and 317 pounds of feed for each 100 pounds of gain produced. This is a difference of 34 pounds as compared with one of 31 pounds in the nine experiments. Although started 5 days later, the pigs in the three tests were ready for market 7 days earlier, or during the fortieth and forty-third weeks of the year, when the weekly average prices were $7.97 and $7.54, respectively.

Under these conditions, the full-fed pigs showed a return, above the cost of the feed and pasture, of $3.02 for each 100 pounds of gain produced. After making allowance for the loss in value on their initial weight, the pigs given a limited feed at first and a full feed later showed a return above the feed and pasture charge of $3.18 for each 100 pounds of gain produced.

Limiting the ration to a less extent or switching the pigs to a full feed earlier would result in faster average gains and probably work out in a somewhat similar manner.

For pigs given a limited feed at first and a full feed later to prove more profitable than pigs that are full fed throughout the feeding period, it is necessary to have them ready for market before too great a drop in price has occurred. In the past, the rapidity and extent of the decline in price has varied greatly from year to year but has usually been greater after than before the third week in October.

From a weight of 125 pounds on, the pigs which were previously given a limited ration required slightly more feed per unit of gain than those that were full fed for the entire time. Thinner pigs usually require less feed per unit of gain than fatter ones. Since the amount of feed consumed was practically the same, the relatively high feed requirement was probably due to a lack of

sufficient forage, or to using too many pigs to the acre for such a method of feeding. The shortage of forage, if any, could have occurred at the beginning of the period due to its having been grazed too heavily in the preceding period or at the close due to the failure of the crop to produce as much new growth late in the fall as earlier. Another possibility, but perhaps a less likely one, would be a lower nutritive value of the forage late in the season than earlier. The finishing period for the full-fed pigs extended from August 26 to October 9. That for the pigs first given a limited ration extended from September 14 to October 30.

LIMITING THE RATION OF LATE-FARROWED PIGS NECESSITATES FINISHING THEM IN DRY LOT

Unless they make exceptionally rapid growth, spring pigs farrowed later than April, even when they are full fed, cannot be fitted for market before a material decline in price, as a rule, has occurred. By limiting their corn allowance until the new crop is available, late-farrowed pigs can be made to utilize a minimum of old and a maximum of new corn. On the other hand, if the ration of late-farrowed pigs is limited during the growing period, they will not be ready for market until after the grazing season is over, or until after it is so late that the forage is of little worth. This necessitates finishing late-farrowed, limited-fed pigs chiefly on concentrates. Fattening shotes having no pasture require more feed per unit of gain than similar shotes on pasture. The larger amount of feed required per unit of gain while finishing them without forage and the lower price apt to be received for them may more than offset the advantage resulting from restricting the ration of late-farrowed pigs at first in order that they may be fed a greater percentage of new, or lower priced, corn.

Twenty comparisons of full and limited feeding of pigs on pasture until an average weight of approximately 125 pounds was reached are summarized in Part 1 of Table 23. The full-fed pigs were fed twice daily in 10 and self-fed in 10 of the comparisons. Twelve of the comparisons were made on rape and eight on red clover pasture. In the case of the limited-fed pigs, neither the rate of growth nor the gain produced from a given quantity of feed differed appreciably from those of the pigs in the experiments reported in Table 22. The full-fed pigs in the 20 experiments gained at approximately the same average rate but required 6 per cent less feed per unit of gain than those in the smaller number of experiments reported in Table 22.

The performance of shotes which were finished on a full feed in dry lot after having received a restricted ration on rape pasture as compared with that of others, while of corresponding weights, which were full fed on pasture after having received a full feed during the growing period is well shown in Part 2 of Table 23. Since the two groups were treated differently in the period preceding the one reported in the table, these data do not furnish information on the fattening of shotes in dry lot as compared with fattening them on forage. Data comparing the feeding of similar shotes in dry lot and on pasture are presented later in Table 24.

In the earlier one of the two trials summarized in Part 2 of Table 23, the nine pigs which were on a restricted ration at first were taken off of the rape pasture when they reached a weight of 132 pounds and fed indoors for the remainder of the test, or for a period of 5 weeks. They then averaged 198 pounds in weight. In the second trial, when the pigs which were on a restricted

ration at first reached an average weight of approximately 120 pounds, they were moved to a nearby plot containing practically no vegetation and finished on a full feed outside, rather than indoors. Thus, except for the forage, the two lots in this test were kept under almost exactly similar conditions during their finishing periods.

TABLE 23.—Full and Limited Feeding of Pigs on Pasture to a Weight of 125 Pounds; Full-fed Pigs Finished on Pasture and Limited-fed Pigs in Dry Lot

	Part 1 Growing period		Part 2 Fattening period		Part 3 Entire time (computed)	
	Full feed	Limited feed	Full feed on pasture, following full feed on pasture	Full feed in dry lot, following limited feed on pasture	Full feed on pasture	Limited feed on pasture; full feed in dry lot
Pigs per acre of forage, estimated, no.	.....	.....	.....	.....	20	15
From	.....	.....	.....	.....	July 10	July 10
To	.....	.....	.....	.....	Nov. 17	Dec. 15
Number of comparisons	20	20	2	2	.....	.....
Pigs at start, no.	220	199	27	25	.....	.....
Initial weight per pig, lb.	53.7	53.9	117.0	123.6	40	40
Pigs at close, no.	212	190	27	25	.....	.....
Final weight per pig, lb.	125.1	123.4	207.5	205.2	210.0	210.0
Total gain per pig, lb.	.....	.....	.....	.....	170	170
Average daily gain, lb.	**1.08**	**0.80**	**1.69**	**1.65**	**1.31**	**1.08**
Days required to gain 85 lb.	79	106	51	52	.....	.....
Daily feed per pig, lb.:						
Corn	3.33	2.12	5.76	6.20	4.24	3.45
Tankage	0.29	0.17	0.43	0.32	0.34	0.22
Salt	0.005	0.002	.....	.....	0.003	0.002
Total	3.63	2.29	6.19	6.52	4.58	3.67
Daily feed per 100 lb. live weight, lb.	**4.06**	**2.59**	**3.81**	**3.97**	.....	.....
Feed per 100 lb. gain, lb.:						
Corn	307.40	263.81	340.09	376.50	323.75	320.15
Tankage	27.02	21.78	25.18	19.75	26.10	20.77
Salt	0.47	0.36	.....	.....	0.23	0.18
Total	**334.89**	**285.95**	**365.27**	**396.25**	**350.08**	**341.10**
Cost of feed per 100 lb. gain	$ 4.24	$ 3.44	$ 3.37	$ 3.58	$ 4.16	$ 3.82
Cost of feed and pasture per 100 lb. gain	$ 4.65	$ 4.54	$ 3.78	$ 3.58	$ 4.57	$ 4.37
Per cent of new corn that could be used	.....	.....	.....	.....	77.6	60.3
Week of year marketed	.....	.....	.....	.....	46th	50th
Selling price a 100 lb.	.....	.....	.....	.....	$ 7.24	$ 6.97
Returns per 100 lb. gain above feed and pasture charge and loss in value on original weight	.....	.....	.....	.....	$ 2.67	$ 2.53

What percentage of their pasture was utilized by the full-fed pigs before and what percentage after they averaged 125 pounds in weight was not known. In determining the cost of their pasture per 100 pounds gain they were assumed to have used half of it in each period. The full pasture charge for the limited-fed pigs was applied to the growing period.

New corn 56¢ and old corn 68.04¢ a bu.; tankage $2.25 and salt 75¢ a 100 lb.; pasture $14.00 an acre.

No tests were conducted in which the plan of limiting the ration of late spring pigs until new corn was available and then full feeding them on pasture until the close of the grazing period and finally finishing them in dry lot was compared with that of full feeding from the start and finishing them on pasture. The pigs in the experiments reported in Table 23 were continued on restricted rations until they averaged approximately 125 pounds in weight.

Assuming that they were farrowed May 1 and that they were placed on feed 70 days later, or July 10, at an average weight of 40 pounds, they would have weighed only 96 pounds by September 18, when it is assumed new corn would be available.

Although not exactly applicable to the conditions under which late pigs on a restricted ration until new corn is available would be fed, computations made from the data in Parts 1 and 2 of Table 23 come perhaps as near indicating the relative returns from the two plans of feeding late pigs as any of the data secured.

If the results for the two periods are combined, it will be seen that if pigs like those used were placed on feed July 10 at a weight of 40 pounds and were kept on pasture until finished, they would gain at the rate of 1.31 pounds daily, reach a weight of 210 pounds by November 17, require 350 pounds of feed per 100 pounds of gain produced, utilize 39.7 per cent of old and 60.3 per cent of new corn, respectively, and show a return of $2.67 (above the cost of the feed and pasture) for each 100 pounds of gain produced.

Similar pigs given a ration restricted like that of the other group until new corn was available and finished in dry lot after the close of the grazing period would gain at the average rate of 1.08 pounds daily, reach a weight of 210 pounds on December 15, and require 341 pounds of feed per 100 pounds of gain produced. They would utilize 22.4 and 77.6 per cent of old and new corn, respectively, but, because of being marketed later, they would bring 27 cents a 100 pounds less than the other pigs and show a return of $2.53, above the cost of the feed and pasture, for each 100 pounds of gain produced. The tankage consumed by the full- and limited-fed pigs amounted to 26 and 21 pounds, respectively, for each 100 pounds of gain.

When based only upon the cost of the feed and pasture, without taking the longer feeding period and, therefore, the additional labor and greater risk involved into consideration, the pigs on the limited ration at first cost 20 cents less a 100 pounds to produce. Placing them on a full feed as soon as new corn was available, or when they were around 96 instead of 125 pounds in weight, would theoretically slightly reduce the feed needed for their maintenance by permitting them to be marketed a little earlier and possibly would also result in them bringing more nearly the same price as the full-fed ones. If so, this would cause the returns from the two methods of feeding to be about the same and would leave the full-feeding method with a shorter feeding period and the chance of a slightly higher selling price in its favor.

COMPARISON OF DRY LOT AND PASTURE FEEDING FOR FATTENING SHOTES

Table 24 gives the comparative results of feeding similar shotes in dry lot and on rape pasture. Previous to the fattening period, or until they averaged approximately 120 pounds in weight, both groups were kept on forage plots containing rape and were fed limited allowances of concentrates. They were then changed to a full feed. One group was left on rape pasture. The other was moved to a nearby half-acre plot containing no forage or green feed. In each period the rations consisted of shelled corn and tankage. The dry-lot group was the same as that in one of the experiments summarized in Part 2 of Table 23. There they were compared with shotes on pasture that were previously full fed; whereas here they were compared with shotes that, like themselves, were previously on a limited ration.

TABLE 24.—Finishing Limited-fed Pigs in Dry Lot and on Pasture

	Shotes finished on pasture	Shotes finished in dry lot
Acres of forage, estimated	0.5	0
Number of pigs	18	16
Initial weight per pig, lb.	117.9	118.8
Final weight per pig, lb.	208.3	208.6
Average daily gain, lb.	**1.84**	**1.60**
Daily feed per pig, lb.:		
Shelled corn	6.32	6.17
Tankage	0.29	0.30
Total	6.61	6.47
Daily feed per 100 lb. of live weight, lb.	4.05	3.95
Feed per 100 lb. gain, lb.:		
Shelled corn	343.09	384.96
Tankage	15.50	18.49
Total	**358.59**	**403.45**
Cost of feed per 100 lb. gain	$ 3.99	$ 4.51
Cost of feed and pasture per 100 lb. gain	$ 4.41	$ 4.51

Shelled corn 59.5¢ a bu.; tankage $2.25 a 100 lb.; rape pasture $13.48 an acre.

The shotes on pasture required 11 per cent less feed or concentrates per unit of gain and gained 15 per cent faster than those having no green feed. Their plot contained one acre, but they were on it during the growing, as well as during the fattening, period. With the pasture valued at $13.48 an acre and that utilized by the 18 shotes while they were between 118 and 208 pounds in weight estimated as equivalent to one-half acre, there was a difference in the cost of 10 cents on each 100 pounds of gain produced in favor of the shotes on forage. Possibly, shotes with greater range would require more feed per unit of gain. Fattening animals, however, are not inclined to exercise any more than is necessary. Hence, this would hardly be expected unless it would be in the case of shotes of a particularly nervous or restless disposition.

DIFFERENT AMOUNTS OF GRAIN FOR SHOTES ON FORAGE

Feeder pigs or shotes weighing 90 pounds or more are sometimes purchased in the spring for feeding on clover or other forage and marketing during the summer or early fall. Less frequently fall pigs are given a minimum of grain, or are "roughed", through the winter and then fattened on forage during the spring and summer on the same farm on which they were produced. A relatively small percentage of pigs may also be farrowed during the winter and weigh 90 pounds or more by the time forage is available for them. The amount of grain shotes should receive would not necessarily be the same as would be advisable for younger or spring-farrowed pigs.

Table 25 gives the results of a test in which three groups of shotes were carried from approximately 140 to 245 pounds in weight on clover pasture. One group was fed corn alone to the extent of 2 pounds daily for each 100 pounds of their live weight. Another was fed approximately the same amount of total feed but was given a fourth of a pound of tankage in place of a part of the corn. The third group was given a full feed of corn and tankage twice daily. They took 3.8 pounds of feed daily for each 100 pounds of their live weight.

TABLE 25.—Full and Limited Feeding of Shotes on Clover Pasture

	Lot 1 **Limited feed** Corn alone	Lot 2 **Limited feed** Corn and tankage	Lot 3 **Full feed** Corn and tankage
From June 16, 1920, to	Sept. 22	Sept. 22	Aug. 11
Acres of forage	0.25	0.25	0.25
Number of pigs	3	3	4
Initial weight per pig, lb.	140.3	138.5	139.2
Final weight per pig, lb.	240.5	242.2	247.1
Average daily gain, lb.	**1.02**	**1.06**	**1.93**
Days required to gain 110 lb. in weight, no.	108	104	57
Daily feed per pig, lb.:			
Shelled corn	3.84	3.62	7.08
Tankage		0.25	0.25
Total	3.84	3.87	7.33
Daily feed per 100 lb. live weight, lb.	**2.02**	**2.03**	**3.79**
Feed per 100 lb. gain, lb.:			
Shelled corn	375.71	341.90	367.32
Tankage		23.63	12.98
Total	**375.71**	**365.53**	**380.30**
Cost of feed per 100 lb. gain	$ 3.99	$ 4.16	$ 4.19
Cost of feed and pasture per 100 lb. gain	$ 5.16	$ 5.29	$ 5.01

Shelled corn 59.5¢ a bu.; tankage $2.25 a 100 lb.; clover pasture $14.00 an acre.

Each pound of tankage fed to the shotes in Lot 2 replaced 1.43 pounds of corn. At the relative prices usually existing, this would not be sufficient to cover the cost of the tankage. The full-fed shotes required more concentrates per unit of gain but utilized less forage and consequently made cheaper gains than those on a limited ration. The full- and the limited-fed shotes made a gain of 110 pounds each in 8 and 15 weeks, respectively.

Table 26 summarizes the results of two experiments in which a 1.5 per cent feed at first and a full feed later were compared with a 3 per cent feed throughout the experiment for shotes on clover pasture.

When the cost of the pasture was included, the shotes getting the 3 per cent feed made cheaper, as well as faster, gains than those getting the 1.5 per cent feed. The shotes given the smaller amount of feed were thinner in condition when averaging 212 pounds in weight, or at the close of the first period, than were those given more grain. During the second period, or while they were on a full feed, the shotes of Lot 1 made more economical gains than those of Lot 2. Their thinner condition at the beginning of the second period was probably at least partially responsible for the favorable showing made.

When both periods were combined there was practically no difference in the cost of the feed and pasture for each 100 pounds of gain produced.

The ration for shotes on pasture should not be limited to too great an extent and the amount fed, especially if it is low at first, should be increased as the feeding period advances. Otherwise, how much to feed should be governed to some extent, at least, by the quantity needed to enable the shotes to reach the weight desired at the time one expects the price to be near its peak.

In periods of declining prices, the price may be higher in July than later. In periods of advancing prices, the price is usually higher in August or September than earlier but drops later in the fall in accord with the usual sea-

sonal fluctuations. In some instances in the past decade, the price has not been as high during the early part of September as it has been a few weeks earlier or later.

TABLE 26.—Different Quantities of Grain for Shotes on Clover Pasture

	Lot 1	Lot 2	Lot 1	Lot 2	Lot 1	Lot 2
	First period		Second period		Entire time	
	1½ per cent feed	3 per cent feed	Full feed following limited feed	3 per cent feed	Limited feed at first; full feed later	3 per cent feed entire time
Average starting date	May 18	May 18	Sept. 3	July 20	May 18	May 18
Average date at close of period	Sept. 3	July 20	Oct. 11	Sept. 6	Oct. 11	Sept. 6
Acres of forage*, no.	0.75	0.467	0.25	0.2	1.0	0.67
Number of trials	2	2	2	2	2	2
Number of pigs	9	11	9	11	9	11
Initial weight per pig, lb.	131.6	131.4	212.6	211.1	131.6	131.4
Final weight per pig, lb.	212.6	211.1	300.4	302.1	300.4	302.1
Average daily gain, lb.	**0.75**	**1.27**	**2.35**	**1.93**	**1.16**	**1.55**
Days required to gain 85 lb., no.	114	67	37	44	.....	.....
Daily feed per pig, lb.:						
Corn	2.59	4.62	8.60	7.61	4.14	5.90
Tankage	0.10	0.19	0.21	0.26	0.13	0.22
Total	2.69	4.81	8.82	7.87	4.27	6.12
Daily feed per 100 lb. live weight, lb.	**1.57**	**2.81**	**3.44**	**3.07**	**1.98**	**2.82**
Feed per 100 lb. gain, lb.:						
Corn	345.60	365.34	365.74	393.60	356.08	380.40
Tankage	13.85	15.02	9.10	13.55	11.38	14.24
Total	**359.45**	**380.36**	**374.84**	**407.15**	**367.46**	**394.64**
Cost of feed per 100 lb. gain	$ 4.17	$ 4.44	$ 4.25	$ 4.70	$ 4.21	$ 4.58
Cost of feed and pasture per 100 lb. gain	$ 5.61	$ 5.19	$ 4.69	$ 4.98	$ 5.13	$ 5.09

*Proportionate amounts of pasture taken in each period estimated.

Shelled corn was fed in one experiment and ground corn in the other. The percentages of ground corn were as follows: First period—Lot 1, 53.5; Lot 2, 60.9 per cent. Second period—Lot 1, 43.4; Lot 2, 55.3 per cent. Entire time—Lot 1, 48.1; Lot 2, 57.8 per cent.

Shelled corn 59.5¢ a bu.; tankage $2.25 and grinding corn 10¢ a 100 lb.; clover pasture $14.00 an acre.

PREPARATION OF CORN AND METHODS OF FEEDING PIGS ON FORAGE

COMPARISON OF EAR, SHELLED, AND GROUND CORN

Table 27 gives the results of an experiment in which ear corn, shelled corn, ground corn fed dry, and ground corn moistened and fed as a slop were compared for feeding with tankage to pigs carried from approximately 50 to 200 pounds in weight on rape pasture.

Since the pigs had been on ground feed previous to the beginning of the experiment, it took those given ear corn a week or two to become accustomed to the change. After that, however, they ate their feed as readily as any of the other groups. With the weight of the cob deducted, there was practically no difference in the feed required per unit of gain produced by the pigs fed ear corn and by those fed shelled corn.

TABLE 27.—Preparation of Corn for Pigs on Rape Pasture

	1	2	3	4
	Ear corn	Shelled corn	Ground corn, dry	Ground corn, moist
	Tankage fed at rate of 0.3 lb. daily a head to all lots			
Number of pigs	6	6	6	6
Initial weight per pig, lb.	49.1	49.3	48.7	48.7
Final weight per pig, lb.	199.5	205.7	201.2	202.2
Average daily gain, lb.	**1.25**	**1.18**	**1.36**	**1.29**
Days required to gain 150 lb., no.	120	128	111	116
Daily feed per pig, lb.:				
Corn (cob deducted)	4.32	4.01	4.46	4.17
Tankage	0.30	0.30	0.30	0.30
Total	4.62	4.31	4.76	4.47
Feed per 100 lb. gain, lb.:				
Corn	344.69	341.05	327.56	323.17
Tankage	23.92	25.52	22.04	23.24
Total	**368.61**	**366.57**	**349.60**	**346.41**
Cost of feed per 100 lb. gain	$ 3.99	$ 4.20	$ 4.30	$ 4.28
Cost of feed and pasture per 100 lb. gain	$ 4.36	$ 4.56	$ 4.67	$ 4.65
Value a bu. as compared with ear corn at 56¢	.....	$ 0.56	$ 0.60	$ 0.60
Value of corn with ear corn in Lot 1 as 100%	.....	100%	107%	107%

Ear corn consisted of 84.7 per cent corn and 15.3 per cent cob.
Ear corn 56¢ and shelled corn 59.5¢ a bu.; tankage $2.25 and grinding corn 10¢ a 100 lb.; rape pasture $13.48 an acre.

The ground corn that was moistened and fed as a slop gave no better results than that fed dry. Each group of pigs had convenient access to an abundance of drinking water at all times.

Both the dry and the moistened ground corn produced more rapid gains than the shelled or ear corn. The pigs given the dry ground corn required 5 per cent less feed per unit of gain than those fed ear or shelled corn. At the prices used and considering only the difference in the feed required per unit of gain, the ground corn was worth 7 per cent more than the ear corn.

The difference in favor of ground corn over shelled corn or ear corn is usually somewhat less than that obtained in this experiment. A summary of three Indiana and three Ohio trials, including this one, with pigs that averaged 85 pounds or less when placed on feed shows that ground corn was worth 5 per cent more on the average than was shelled corn. The initial and final weights were approximately 60 and 220 pounds per pig, respectively. Since older pigs are more inclined to bolt their feed than younger ones, the advantage of ground corn over shelled corn increases as the pigs become heavier.

Possibly grinding corn would be advisable under conditions in which rapid gains were of greater importance than the cost of the gains. In the six trials the pigs receiving the ground corn gained 7 per cent faster than those receiving shelled corn.

In three Indiana and four Ohio trials, with pigs started at weights of 80 pounds or less, shelled corn was worth only 0.7 of a per cent more than ear corn. Both produced gains at practically the same rate.

SELF AND HAND FEEDING

Ten experiments comparing full feeding twice daily and self feeding pigs on forage are summarized in Table 28. The pigs were on clover pasture in three and rape pasture in seven of the trials. Shelled corn was fed in six and ground corn in four. The hand-fed pigs were given an average of approximately 0.3 pound of tankage daily a head. The tankage and corn were self fed separately in all of the tests in which shelled corn was used and in one in which ground corn was used. In the other three experiments the ground corn and tankage, and in two instances salt as well, were mixed in definite proportions rather than self fed separately, or free choice.

The self-fed pigs gained somewhat faster and were ready for market 10 days earlier on the average than the hand-fed pigs. Due to consuming a little more tankage than was given the hand-fed pigs and to their requiring slightly more feed per unit of gain, the cost of each 100 pounds of gain produced was 11 cents higher for the self-fed than for the hand-fed pigs.

TABLE 28.—Self and Hand Feeding Pigs on Pasture

	1	2
	Full fed twice daily	**Self fed**
Acres of forage	5	5
Number of trials	10	10
Number of pigs	100	100
Initial weight per pig, lb.	57.1	57.6
Final weight per pig, lb.	203.2	204.5
Average daily gain, lb.	**1.28**	**1.41**
Days required to gain 150 lb., no.	117	107
Daily feed per pig, lb.:		
Corn	4.29	4.74
Tankage	0.29	0.37
Salt	0.004	0.005
Total	4.58	5.11
Daily feed per 100 lb. live weight, lb.	**3.52**	**3.90**
Feed per 100 lb. gain, lb.:		
Corn	334.86	336.34
Tankage	22.40	26.15
Salt	0.35	0.36
Total	**357.61**	**362.85**
Cost of feed per 100 lb. gain	$ 4.18	$ 4.28
Cost of feed and pasture per 100 lb. gain	$ 4.65	$ 4.76

Four hand-fed and four self-fed pigs were removed from the lots during the course of the experiments. The total pig days for the hand- and self-fed lots were 11,109 and 10,059, respectively. The total gains were 14,238.13 pounds for Lot 1 and 14,161.667 pounds for Lot 2.

Each group utilized a total of 1.5 acres of clover and 3.5 acres of rape.

Shelled corn was fed in six and ground corn in four of the experiments. The shelled corn made up 66.7 and 65.14 per cent of the total for the hand- and self-fed pigs, respectively.

Shelled corn 59.5¢ a bu.; tankage $2.25, salt 75¢, and grinding corn 10¢ a 100 lb.; red clover pasture $14.00 and rape pasture $13.48 an acre.

At the Ohio Station, corn and steam-rendered tankage have been self fed separately to 13 groups of growing and fattening pigs which were running on forage. Nine of the groups were on rape pasture, three on red clover, and one on a mixture of bluegrass and white clover. The tankage consumed averaged

6.8 per cent of the total concentrates and thus did not differ greatly from the average percentage that would be used if the feeds were mixed or if the tankage were hand fed at a given rate daily a head. There was a wide variation, however, in the relative amounts of the two feeds consumed in different experiments. In one trial on rape and in one on red clover the tankage taken represented less than 4 per cent of the total concentrates. On the other hand, in one trial on each of the two crops, it represented more than 12 per cent of the total feed. Differences in the quality of the forage would affect the percentage of supplement needed to some extent but would hardly cause it to vary so drastically.

Although pigs may usually take approximately the correct proportions of the two feeds, these wide variations indicate that they cannot always be depended upon to balance their own ration satisfactorily when the feeds are self fed separately, even though they consist of corn and steam-rendered tankage.

Dry-rendered tankage is especially palatable. In an experiment on clover pasture, pigs self fed dry-rendered tankage and corn separately during the time they were between 53 and 177 pounds in weight consumed a pound of tankage for every 6.1 pounds of corn. Since it contained 60 per cent of protein, this undoubtedly was more than was needed for the most economical gains.

An experiment is reported in Table 29 in which ear corn, fed twice daily, was compared with shelled corn fed in the same way and also with shelled corn that was self fed. The pigs were on rape pasture, and tankage was used as a supplement.

TABLE 29.—Method of Feeding Corn to Pigs on Rape Pasture

	1 Ear corn and tankage twice daily	2 Shelled corn and tankage twice daily	3 Shelled corn and tankage self fed separately
Acres of forage, approximate	0.9375	1.0	0.875
Number of pigs	19	19	20
Initial weight per pig, lb	52.0	52.3	52.6
Final weight per pig, lb	201.6	206.7	204.2
Average daily gain, lb	**1.18**	**1.23**	**1.32**
Days required to gain 150 lb., no	128	122	114
Daily feed per pig, lb.:			
Corn (cob deducted)	3.92	4.00	4.39
Tankage	0.30	0.30	0.32
Total	4.22	4.30	4.71
Feed per 100 lb. gain, lb.:			
Corn	332.83	326.39	331.17
Tankage	25.95	24.66	24.04
Total	**358.78**	**351.05**	**355.21**
Cost of feed per 100 lb. gain	$ 3.91	$ 4.02	$ 4.06
Cost of feed and pasture per 100 lb. gain	$ 4.38	$ 4.48	$ 4.51

Ear corn consisted of 82 per cent corn and 18 per cent cob.

A 46-lb. pig was taken out of Lot 1 after 14 days. A 55-lb. and a 67-lb. pig were taken out of Lot 3 after 14 days, and a 73.5-lb. one after 42 days.

Ear corn 56¢ and shelled corn 59.5¢ a bu.; tankage $2.25 a 100 lb.; rape pasture $13.48 an acre.

The pigs that were self fed shelled corn were ready for market 8 days earlier than those fed shelled corn twice daily and 14 days earlier than those fed ear corn. Slightly more corn per unit of gain was required when it was

self fed, but the difference was probably too small to be of any significance. With the ear corn valued at 56 cents a bushel, the shelled corn showed a comparative value of 57 cents a bushel when self fed and 57.7 cents a bushel when hand fed.

Thus, the data obtained show that ordinarily, in the summer at least, it is advisable to feed ear corn rather than go to the expense of shelling or of shelling and grinding it for pigs. Self feeding is not as well adapted to the feeding of ear corn as to the feeding of shelled or ground corn. When ear corn is self fed, a pig will take an ear, carry it some distance from the feeder, take a few bites from it, and then return for a fresh ear. In wet weather a part of the corn is wasted from being trampled in the mud or from being left after having become soiled. Although less satisfactory for the purpose than shelled corn, if pigs are made to clean up the corn they have scattered about before they are given a new supply and if the feeding place is changed from time to time, it is possible to self feed ear corn to pigs during the summer months while they are running on pasture.

Perhaps a more feasible plan of feeding ear corn is to haul it to the field in an old wagon and scoop out as much each morning and evening as the pigs will clean up readily. The feeding place can be changed with each new load, or as often as it is desired. A plan followed by some feeders which reduces handling to a minimum is to store the corn as it is harvested in rail or movable cribs placed in the field where the hogs are to be kept the following year. The cribs can be located at different points in the field and the feeding place thus changed when the supply of corn in one crib is exhausted.

Since pigs would be likely to eat whatever feed was available whenever they became hungry and thus take more of the relatively high-priced supplement than would be needed to balance the ration, self feeding the tankage or other protein feed alone when the corn is hand fed would not be considered advisable. By mixing ground oats or some less palatable feed with it, however, tankage can be self fed successfully even when the corn is fed twice daily and is not before the pigs at all times.

When a mixture of ground oats 4, tankage 1 was self fed to pigs on clover pasture and the corn was hand fed, the tankage consumed amounted to 4.3 per cent of the total feed. Inasmuch as this was somewhat less than is desirable, perhaps a mixture of 1 pound of tankage to 2.5 or 3 pounds of oats would be more nearly correct. By manipulating the ratio of oats to tankage it should not be difficult to get pigs to consume the approximate amount of tankage needed.

While under 100 pounds in weight, full-fed pigs on good pasture need from 0.25 to 0.3 pound of tankage, or its equivalent in some other protein feed, daily a head. Shotes over 100 pounds in weight need from 0.3 to 0.4 pound daily a head, depending upon the amount of grain and the quality and quantity of forage consumed.

SUMMARY

THE WORTH OF PASTURE FOR PIGS AND FACTORS INFLUENCING ITS VALUE

Pigs on pasture gained almost a quarter of a pound more daily a head and were ready for market 24 days earlier than similar pigs having no forage.

Green feed not only caused the pigs to consume a larger amount of grain and gain more rapidly but also enabled them to make more effective use of the grain or concentrates consumed. At the prices used and when only the saving in feed per unit of gain in live weight was taken into account, the pasture was worth $16.27 an acre.

Increasing receipts cause hog prices to decline in the fall as the season advances. As determined from average market prices for a number of years, the earlier time of marketing resulted in an additional difference in returns of $16.53 for each acre of forage in favor of the pasture-fed over the dry lot-fed pigs.

Pasture has the further advantage of helping to keep the pigs in a healthy, vigorous condition.

A suitable forage crop is palatable and succulent, low in fiber, and high in minerals and protein. The worth of the crop is influenced by the ease and cheapness of seeding, its ability to produce new growth, remain green, and withstand grazing, and its adaptability to local conditions.

As plants mature they become more woody or fibrous in character and decrease in ash or minerals and in protein.

During the early stages of their development, such crops as bluegrass, rye, wheat, and oats compare favorably with alfalfa, red clover, sweet clover, alsike, soybeans, and field peas in their protein content. As they mature they lose their nitrogenous character and no longer show as high a nutritive value.

Excessively heavy grazing is not advisable. On the other hand, if alfalfa, red clover, bluegrass, Sudan grass, or similar crops are not kept grazed down sufficiently to cause a maximum of new growth, they should be clipped one or more times during the season.

VARIOUS FORAGE CROPS COMPARED

Alfalfa was unsurpassed, among the crops tried, as a forage for growing and fattening pigs. In the tests summarized and at the prices used, it was worth $5.94 more an acre than red clover.

Red clover, if it was not dry and woody, compared favorably with alfalfa in nutritive value but was hardly equal to it in carrying capacity or drouth resistance. Clover has the advantage of being grown in the rotations commonly used in the Corn Belt.

Alsike provided very little forage after midsummer. Even during the period that alsike furnished green feed, red clover not only produced faster gains but also saved sufficient feed per unit of gain to make it worth $10.65 an acre more than the alsike.

Dwarf Essex rape ranked high as an annual forage crop for pigs. In three comparisons with each crop it was worth within 3.2 per cent as much as red clover and within 8.6 per cent as much as alfalfa an acre. Although the lesions were not often severe, rape sometimes caused the pigs to blister or sunscald. White or thin-skinned pigs are the most susceptible to sunscalding.

Mixtures of oats and field peas or of field peas, oats, or soybeans with rape produced slower gains and less gain per unit of concentrates fed than did rape alone.

Soybean pasture compared favorably with red clover and rape insofar as the performance of the pigs was concerned. The foliage of soybeans was especially palatable to pigs. Chiefly because (a) of its shorter season, as a result of maturing quickly or being killed by frost, and (b) of its lower carrying capacity, as a result of producing little or no new growth after being grazed, soybean pasture was less valuable per acre than rape.

Sudan grass produced an abundance of fairly palatable forage, but the data obtained indicated that its nutritive value was not equal to that of such crops as rape or soybeans. Like soybeans, it is killed by frost and so provides pasture for only a relatively short time.

Sweet clover was distasteful to the pigs. Although they had no other forage, they did not learn to eat it readily. It was seeded in the spring and pastured the first season. The second year's growth is too coarse and woody to be suitable for pigs. In four trials, the average value of sweet clover was $6.70 less an acre than that of rape pasture.

Spring-sown winter wheat does not head out but remains recumbent in its habit of growth. Sweet clover that is seeded rather late in the spring without a nurse crop is apt to become weedy. Wheat seeded with it not only helps to control the weeds but also provides excellent forage during the early part of the grazing period. When sown in the spring, winter wheat usually dies out during the latter part of July. A combination of sweet clover and spring-seeded winter wheat compared more favorably with rape than did sweet clover alone.

Peruvian alfalfa, which is a rapid growing strain that is commonly grown in the Southwest but that winterkills in the North, was seeded in the spring and pastured the first season (that is, used in the same way as sweet clover). The pigs on Peruvian alfalfa required less feed per unit of gain in two out of three trials and made slightly faster gains in each of the three tests than did similar pigs on sweet clover. The saving in feed alone made the alfalfa worth 8 per cent more an acre than the sweet clover. Wheat was sown with both the sweet clover and the alfalfa in two of the experiments.

A mixture of Peruvian alfalfa and spring-seeded winter wheat apparently was capable of carrying only about 90 per cent as many pigs to the acre, but otherwise it was fully equal, if not superior, to rape as a forage for pigs. An advantage favoring the mixture was that it caused no sunscalding. Indications were that as an annual forage the mixture was of special merit.

Bluegrass makes good early pasture. During the summer months, however, it showed a relatively low value. If other hogs have been on it a year or two previously, bluegrass may have become contaminated with round worm eggs and be objectionable on this account.

PROTEIN AND MINERAL SUPPLEMENTS TO GRAIN FOR PIGS ON PASTURE

The need for a protein supplement to corn by pigs on pasture was influenced by the age of the pigs and the proportion of forage to grain consumed. The protein content or quality of the forage also influences the amount of supplement needed.

Each pound of tankage fed to pigs carried from approximately 50 to 170 pounds in weight replaced 2.66 pounds of corn. Each pound fed to pigs carried from 65 to 195 pounds in weight replaced 2.4 pounds of corn. The rations contained averages of 6.5 and 5.4 per cent of tankage, respectively.

Each pound of tankage fed to pigs which were given a limited amount of grain, or approximately 3 pounds daily for each 100 pounds of their live weight, and which, therefore, ate a larger proportion of forage than is consumed by full-fed pigs replaced only 1.27 pounds of corn.

The use of tankage or of a protein supplement increased the rapidity of the gains regardless of the age of the pigs. The increase was greater in the case of young than in the case of older pigs.

Pigs given no protein supplement ate noticeably larger amounts of forage than those given tankage or some other high-protein feed. Obviously, they attempted to make up in this way for the deficiency in the concentrate portion of their ration.

Calculations made from recognized feeding standards indicated that, when full fed on pasture, pigs under 100 pounds in weight should be given not less than 65 to 70 per cent as much supplement as similar pigs in dry lot.

Depending on the quality of the forage, full-fed pigs between 100 and 150 pounds in weight need from 50 to 70 per cent as much protein supplement as similar pigs in dry lot. If the forage is of exceptional quality, shotes that are over 150 pounds in weight may need no protein supplement. Otherwise, they should probably be given from 25 to 50 per cent as much supplement as similar shotes in dry lot.

The addition of minerals improved a ration of corn and salt for full-fed pigs on pasture but to a less extent than did the addition of a protein supplement. When used with corn and salt to make up 2 per cent of the total feed, each pound of minerals replaced 5.9 pounds of corn. Furthermore, by producing more rapid growth, minerals enabled the pigs to be marketed 15 days earlier. With the salt included, the minerals made up 2.5 per cent of the total feed.

Minerals were also beneficial for feeding with corn and the protein feeds of plant origin to pigs on pasture. Each pound of minerals fed with corn and soybean oilmeal saved 3.4 pounds of corn and 0.8 pound of soybean oilmeal.

Minerals were of less importance with tankage than with the protein feeds of plant origin. When fed with corn and tankage, however, the minerals produced slightly faster gains, which permitted the pigs to be marketed 7 days earlier, and each pound used replaced 2.6 pounds of corn and 0.4 pound of tankage.

If the minerals are self fed separately, pigs may fail to take sufficient quantities for optimum results. By mixing the minerals with the supplement mineral consumption in relation to that of the other feeds can be more nearly controlled. Little information is available on the most desirable percentage of minerals to supplement. Theoretically, the quantity should vary indirectly with the ratio of supplement to grain fed. Although used in larger amounts in the experiments reported, possibly one pound of minerals to every 6 pounds of tankage or to every 5 pounds of supplement, if it is of plant origin, would prove satisfactory.

Nothing was gained by adding minerals, other than salt, to corn and tankage when a limited ration was fed. Limiting the ration increases the amount of forage consumed and forage is relatively high in ash or minerals.

In contrast to dry-lot feeding, in which certain combinations of high-protein feeds have proved more effective than any one of the feeds used alone, mixtures of two or more protein feeds were not superior to a single protein supplement for pigs running on good pasture.

For pigs under 70 pounds in weight at the beginning of the experiments, uncooked soybeans and corn germ meal made relatively poorer showings than the other supplements tried. Raw soybeans were distasteful to the pigs. As pointed out in Ohio Agricultural Experiment Station Bulletin 452, there is also danger of soybeans causing soft pork if they are used throughout the growing and fattening period in sufficient quantities to balance corn. Because of its relatively low protein content, one pound of corn germ meal to three of corn was fed. The ration containing it at this level was lacking somewhat in palatability.

Skimmed milk, fish meal, tankage, soybean oilmeal, linseed meal, buckwheat middlings, and boiled soybeans were all satisfactory as supplements to corn for pigs on pasture. Which of these, or of other suitable supplements, it is advisable to use depends to a large extent upon their relative cost per unit of protein contained.

When the ground is soft pigs that are not rung may do some rooting, regardless of how they have been fed. Those given a protein supplement or minerals or both, however, did very little rooting; whereas those fed only corn and salt sometimes did an excessive amount of rooting.

DIFFERENT AMOUNTS OF GRAIN OR CONCENTRATES FOR PIGS ON FORAGE

Pigs on pasture that were fed a limited amount of grain or concentrates ate more forage, gained more slowly, and required fewer pounds of concentrates per unit of gain than full-fed pigs.

Full-fed pigs consumed around 4 pounds of feed daily for each 100 pounds of their live weight. Pigs given a daily feed approximating 2.5 per cent of their weight were not ready for market until 57 days later than full-fed ones.

Hog prices practically always decline in the fall as the number being marketed increases; hence, limited-fed pigs usually bring lower prices than full-fed ones which gain more rapidly and are marketed earlier. The lower selling price applies not only to the gains made but also to the original weight of the pigs.

A larger percentage of new or relatively low priced corn can be utilized by limited- than by full-fed pigs. This partially offsets the disadvantage of a lower selling price.

With the average difference in selling price and the loss in value on the original weight of the limited-fed pigs taken into account, the returns above the feed and pasture charge were 77 cents greater per 100 pounds of gain produced for the full-fed than for the limited-fed pigs.

Pigs limited to approximately 2.5 pounds of feed daily for each 100 pounds of their live weight until they were around 125 pounds in weight and full fed thereafter were ready for market 3 weeks later on the average than similar pigs that were full fed for the entire time. This plan of feeding corresponds somewhat to that of dividing the life of market pigs after weaning into a growing and a fattening period and permits the use of new corn for a large share of the full feeding or fattening period. The average returns above the

cost of the feed and pasture and the loss in value on the original weight of the pigs, due to the lower price received as a result of later marketing, were 19 cents less per 100 pounds than were the returns on similar pigs that were full fed for the entire time. The average starting date was June 21. The pigs averaged 88 days of age and 54 pounds in weight at the beginning of the experiments.

Pigs farrowed 2 weeks earlier, pigs gaining as rapidly as those in some of the experiments, pigs given a ration limited to a less extent (or to 3 instead of 2.5 per cent of their weight), or pigs changed to a full feed when around 100 pounds in weight but otherwise fed in the above manner would have shown slightly greater returns per unit of gain than similar pigs full fed for the entire time.

Unless they make exceptionally rapid gains, pigs farrowed later than April cannot be fitted for market as a rule before a material decline in the price of hogs has occurred, even when they are full fed. By limiting their corn allowance until the new crop is available, later farrowed pigs can be made to utilize a minimum of old and a maximum of new corn. When the ration of late-farrowed pigs was limited during the growing period, however, they were not ready for market by the close of the grazing season and so had to be finished in dry lot or without pasture. Late pigs that were full fed throughout their lives, on the other hand, were ready for market by the close of the grazing season.

Fattening shotes previously fed a limited ration on pasture required more feed per unit of gain while being finished in dry lot than shotes of a similar weight which were finished on pasture and which had previously received a full feed rather than a limited feed. Hence, the necessity of finishing limited-fed late pigs without forage tends to offset the advantage of their being able to utilize a larger percentage of new or lower priced corn. Although no direct comparisons were made, computations from other data indicated that the returns to be expected from the two plans of feeding late spring pigs were not greatly different. Full feeding for the entire time has a shorter feeding period and the chance of a slightly higher selling price in its favor. Shortening the feeding period reduces the labor, the overhead charges, and the risk of losses from disease.

FINISHING FEEDER SHOTES

When groups which had both previously received limited rations on pasture were compared, the shotes finished on pasture required 11 per cent less feed per unit of gain and gained 15 per cent faster than those finished in dry lot. When the value of the pasture at the prices used was taken into account, those shotes on pasture made their gains for 10 cents less a 100 pounds than did those in dry lot.

Each pound of tankage fed with corn to shotes on clover pasture, carried from approximately 140 to 240 pounds in weight and given an allowance of concentrates which was limited to 2 pounds daily for each 100 pounds of their live weight, replaced 1.43 pounds of corn, or an insufficient amount to justify its use under usual conditions.

Full-fed shotes on pasture made more economical gains than similar ones that were given a limited amount of grain. A factor having some influence on the amount of grain to feed is the time at which one wishes to market hogs

that are started as feeder shotes and fattened on pasture. If the grain is restricted, it should probably not be limited to less than 2 per cent of the live weight daily and then gradually increased as the fattening period advances.

PREPARATION AND METHOD OF FEEDING CORN

Ear corn and shelled corn were of practically equal value for pigs.

Ground corn in the test reported was worth 7 per cent more per bushel than shelled or ear corn. A summary of six experiments, including the one reported, with pigs having an initial weight of 85 pounds or less showed ground corn to be worth 5 per cent more, on the average, than shelled corn. The advantage of grinding increased as the pigs became heavier. Unless corn is unusually high in price, grinding is seldom advisable.

In the six trials the pigs receiving ground corn gained 7 per cent faster, or reached a weight of 220 pounds 9 days earlier, on the average, than those receiving shelled corn. Possibly grinding would be desirable under conditions in which rapid gains are of greater importance than the cost of the gains.

Ground corn that was moistened and fed as a slop gave no better results than that fed dry.

Self-fed pigs were ready for market 10 days earlier, on the average, than were similar pigs that were full fed twice daily.

Due to their consuming a little larger percentage of tankage and requiring slightly more feed per unit of gain, the cost of each 100 pounds of gain produced was 11 cents higher for the self- than for the hand-fed pigs.

The average amount of tankage consumed by the self-fed pigs in the different experiments ranged from less than 4 to more than 12 per cent of the total concentrates. Although the pigs usually balance their ration fairly satisfactorily when corn and steam-rendered tankage are self fed separately, this wide variation indicates that they cannot always be depended upon to eat the feeds in the approximate ratios which will prove the most economical. Dry-rendered tankage was especially palatable. Pigs on excellent clover pasture self fed dry-rendered tankage and corn separately consumed 1 pound of tankage for every 6.1 pounds of corn.

Self feeding is not as well adapted to the feeding of ear corn as it is to the feeding of shelled or ground corn. A feasible plan of feeding ear corn is to haul it to the field in an old wagon and scoop out as much each morning and evening as the pigs will clean up readily.

If ear corn is fed twice daily, pigs under 75, between 75 and 125, and over 125 pounds in weight may be given 0.25, 0.3, and 0.4 pound of tankage, or its equivalent in some other high-protein feed, daily a head.

By mixing ground oats or some other less palatable feed with it, if necessary, the tankage or supplement can be self fed successfully even when the corn is fed twice daily. A mixture of 2.5 pounds of ground oats to each pound of steam-rendered tankage is estimated to be somewhere nearly correct. The ratio, however, can easily be manipulated until the pigs take approximately the correct amount of supplement needed.

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